

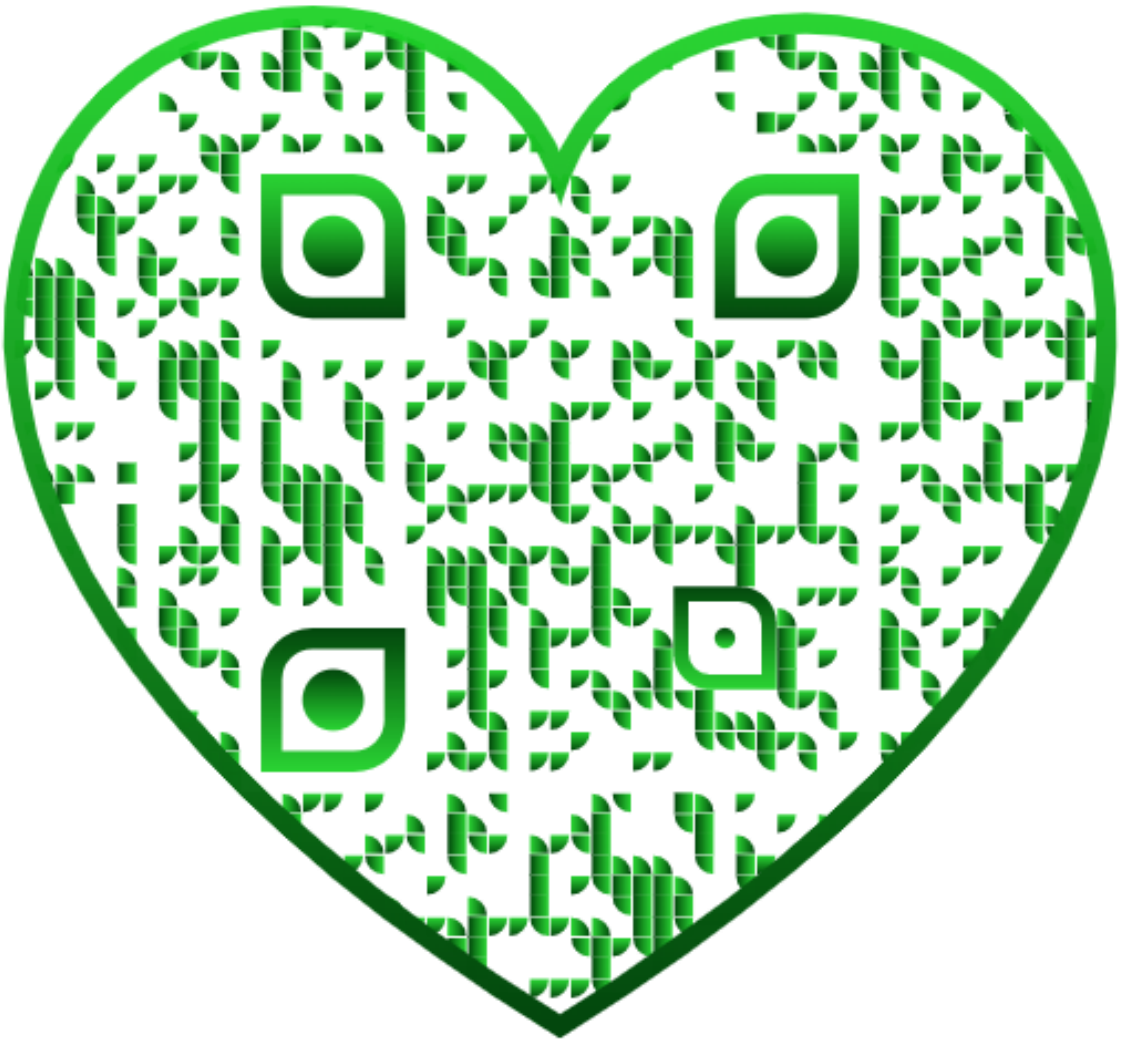
Federal Democratic Republic of Ethiopia
Ministry of Health

Pediatric Hospital Care: ETHIOPIA

POCKET BOOK

Guidelines for the Management of Common Illnesses in Hospitals

(Second Edition, 2016)



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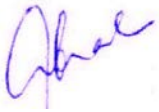
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Abbrevations

ACT	Artemisinin Combination Therapy
AIDS	acquired immunodeficiency syndrome
AVPU	**A**lert, responding to **V**oice, responding to **P**ain, **U**nconscious)
BP	blood pressure
CMV	cytomegalovirus
CSF	cerebrospinal fluid
DPT	diphtheria, pertussis, tetanus
EPI	expanded programme of immunization
FG	French gauge
G6PD	glucose 6-phosphate dehydrogenase
HIV	human immunodeficiency virus
HUS	haemolytic uraemic syndrome
IM	intramuscular injection
IMCI	Integrated Management of Childhood Illness
IV	intravenous injection
JVP	jugular venous pressure
LIP	lymphoid interstitial pneumonitis
LP	lumbar puncture
NG	nasogastric
OPV	oral polio vaccine
ORS	oral rehydration salts
ORT	oral rehydration therapy
PCP	Pneumocystis carinii pneumonia

PCV packed cell volume

PPD purified protein derivative (used in a test for tuberculosis)

ReSoMal rehydration solution for malnutrition

RDA recommended daily allowance

RUTF Ready to Use Therapeutic Food

SAM Severe Acute Malnutrition

SD standard deviation

STI sexually transmitted infection

TB tuberculosis

TMP trimethoprim

TPHA treponema pallidum haemogglutination assay

SMX sulfamethoxazole

UTI urinary tract infection

VDRL veneral disease research laboratories

WBC white blood cell count

WHO World Health Organization

°C degrees Celsius

°F degrees Fahrenheit

CHAPTER 1-TRIAGE AND EMERGENCY CONDITIONS

1.1 Triage

TRIAGE is the sorting of patients into priority groups according to their need and the resources available.

Many deaths in hospital occur within 24 hours of admission. Some of these deaths can be prevented if very sick children are quickly identified on their arrival and treatment is started without delay.

Categories after Triage	Action required
EMERGENCY CASES	Need immediate emergency treatment
PRIORITY CASES	Need assessment and rapid attention
QUEUE CASES	Can wait their turn in the queue

The ABCDO concept

Triage of patients involves looking for signs of serious illness or injury. These emergency signs related to the Airway-Breathing-Circulation/Consciousness-Dehydration/Disability, and Other Emergencies are easily remembered as "ABCDO".

A	**A**irway
B	**B**reathing
C	**C**irculation, **C**oma, **C**onvulsion
D	**D**ehydration (severe), **D**isability
O	**O**thers (immediate Poisoning, Major Trauma with open fracture, Bleeding Child)

Each letter refers to an emergency sign which, when positive, should alert you to a patient who is seriously ill and needs immediate assessment and treatment.

Emergency signs include:

- obstructed or absent breathing
- severe respiratory distress
- central cyanosis
- signs of shock (cold hands, capillary refill time longer than or equal to 3 seconds, weak and fast pulse)
- coma (or seriously reduced level of consciousness)
- convulsions
- signs of severe dehydration in a child with diarrhoea
- Disabilities like motor deficit (paraplegia/paresis, hemiplegia/paresis, facial palsy…)
- Other emergency signs (bleeding child, immediate poisoning, Major Trauma)

Bleeding child:

- Bleeding due to trauma
- Spontaneous bleeding (epistaxis, hematemesis, rectal bleeding, umbilical bleeding…)

Immediate poisoning:

- Acute eye or skin poisoning
- Ingested poison within one hour

Major trauma:

- Compound (open) fracture

Priority signs

These children need prompt assessment (no waiting in the queue). These signs can be remembered with the mnemonic 3 TPR - MOB:

- Tiny baby: any sick child aged less than two months
- Temperature: child is very hot or very cold
- Trauma or other urgent surgical condition
- Pallor (severe)
- Poisoning (other than those that require emergency care)
- Pain (severe)
- Respiratory distress

- Restless, continuously irritable, or lethargic
- Referral (urgent)
- Malnutrition: Visible severe wasting
- Oedema of both feet
- Burns

The triaging process should be short (average of 20 seconds) and a continious processes with frequent assessment. One of the following can be used to differentiate the groups:

-Stamp method or

-Colored sticker (Red, Yellow, Green)

Chart 1: Sick Child triage chart

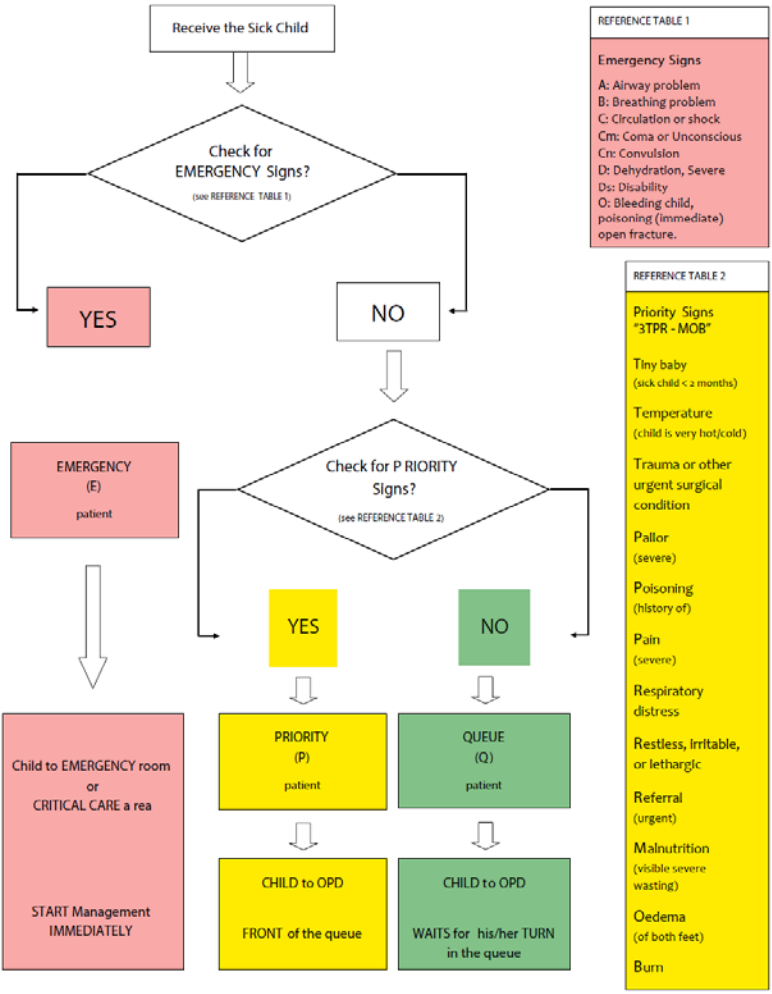


Table 1.1: Emergency management of triaged children

EMERGENCY(E) SIGNS: If any sign positive: give treatment(s) for ABCDO, call for help, draw blood for emergency laboratory investigations (glucose, malaria smear, Hb and cross match if necessary)

		TREAT
1. ASSESS: AIRWAY AND BREATHING ■ Obstructed or absent breathing ■ Central cyanosis ■ Severe respiratory distress	**Any Sign Positive**	■ Do not move neck if cervical spine injury possible. ■ If foreign body aspiration: manage airway in choking child ■ If no foreign body aspiration: manage airway ■ Give oxygen
2. ASSESS: CIRCULATION ■ Cold skin with: – Capillary refill longer than 3 seconds, and – Weak and fast pulse	**Signs Positive** **Check for Severe Malnutrition**	■ Stop any bleeding ■ Give oxygen ■ Make sure child is warm **If no severe malnutrition:** – Insert an IV and begin giving fluids rapidly – If not able to insert peripheral IV, insert an intraosseous or external jugular line **If severe malnutrition:** ■ If lethargic or unconscious: – Give IV glucose – Insert IV line and give fluids ■ If not lethargic or unconscious: – Give glucose orally or by NG tube – Full assessment and treatment
3. ASSESS: COMA/ CONVULSION ■ Coma OR ■ Convulsing (now)	**If the Child is in Coma or Convulsing**	■ Do not move neck if cervical spine injury possible ■ Manage airway – If convulsing, give diazepam rectally – Position the unconscious child (if head or neck trauma is suspected, stabilize the neck first ■ Give IV glucose

<table>
<tr>
<td>4. ASSESS: SEVERE DEHYDRATION
(In a child with diarrhoea)
Diarrhoea plus any two of these signs:
■ Lethargy
■ Sunken eyes
■ Very slow skin pinch
■ Unable to drink</td>
<td>Two Signs Positive
Check for Severe Malnutrition</td>
<td>■ Make sure child is warm
If no severe malnutrition
■ Insert an IV line and begin giving fluids rapidly
If severe malnutrition:
■ Do not insert IV
■ Proceed immediately to full assessment and treatment</td>
</tr>
<tr>
<td>5. OTHERS: MAJOR TRAUMA, IMMEDIATE POISONINGS
■ Immediate poisoning, actively bleeding child, compound fracture</td>
<td>Any Sign Positive</td>
<td>■ Manage ABC
■ Airway Protection
■ Arrest bleeding
■ Decontaminate acute poisoning
■ Stabilize fracture</td>
</tr>
<tr>
<td colspan="3">Proceed with assessment and further treatment according to the child's priority</td>
</tr>
<tr>
<td>PRIORITY(P) SIGNS:
These children need prompt assessment and treatment
■ Tiny baby (<2 months)
■ Temperature very high or cold
■ Trauma or other urgent surgical condition
■ Pallor (severe)
■ Poisoning (history of)
■ Pain (severe)
■ Respiratory distress
■ Restless, continuously irritable, or lethargic
■ Referral (urgent)
■ Malnutrition: visible severe wasting
■ Oedema of both feet or face
■ Burns (major)</td>
<td>Any Sign Positive</td>
<td>Move a child with any priority sign to the front of the queue
Note: If a child has trauma or other surgical problems, get surgical help or follow surgical guidelines</td>
</tr>
<tr>
<td>NON-URGENT(Q)</td>
<td></td>
<td>■ The child can wait her/his turn in the queue for assessment and treatment</td>
</tr>
</table>

When a child with emergency signs is identified, start the appropriate emergency treatments immediately. Do not proceed to the next step before treatment is begun for a positive sign. If the child has no emergency signs, check for priority signs.

General Treatment for Priority Signs

While waiting, supportive treatments should be given. For example, a child who is febrile should receive antipyretic such as paracetamol. Similarly, a child with a burn may have severe pain and the pain should be controlled while waiting for definitive treatment.

1.2 Airway and Breathing

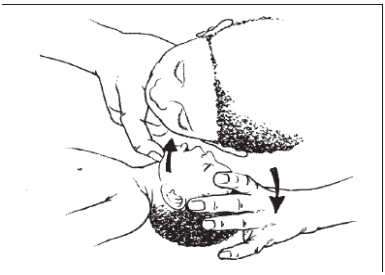
The letters A and B in "ABCDO" represent "Airway and Breathing". If there is no problem with the airway or breathing, you should look for signs in the areas represented by C.

Assessment and management of the Airway and Breathing

- Is the child breathing?
- Is the airway obstructed?
- If the child is not breathing, or if the child has severe respiratory distress, is there an obstruction to the flow of air?

Table 1.2: **Assessment and treatment of airway and breathing**

AB AIRWAY AND BREATHING	▪ Not breathing ▪ Central cyanosis, or ▪ Severe respiratory distress ▪ If yes, is the breathing obstructed	Any Sign Positive	▪ Manage airway ▪ Give oxygen ▪ Make sure the child is warm
Check for head/neck trauma before treating the child; do not move neck if cervical spine injury is possible.			



Assessment of an obstructed Airway

- **LOOK**

Is the chest moving?

- **LISTEN**

Listen for any breath sounds. Are they normal?

- **FEEL**

Figure 1.1: Look, Listen, Feel

Can you feel the movement of air through nose or mouth of the child?

The following signs suggest that the upper airway is obstructed

- Increased inspiratory effort with retraction
- Abnormal respiratory sounds (e.g. stridor)
- Lack of breath sounds despite respiratory effort (i.e. complete airway obstruction)

If the child is not breathing or if the airway appears obstructed, you must first open the airway.

Management to open the airway

If the upper airway is obstructed, use the following techniques:

Simple techniques to open the airway

1. Open the airway with head tilt–chin lift for non-trauma patients or jaw trust for trauma or suspected trauma patients
2. Clear the airway by suctioning the mouth and nose
3. Perform techniques to remove foreign body obstructing the airway
4. Use airway adjuncts (e.g. oral airway)
5. Avoid unnecessary agitation which worsens the obstruction

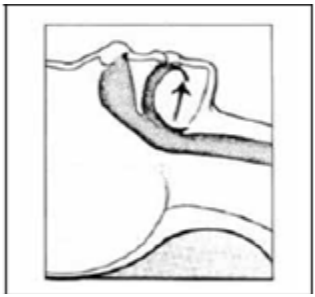
Maneuvers to open the airway

Manage anatomic obstruction (hypo-pharyngeal tissue blocking the airway). If a patient is not properly positioned, there will be anatomic obstruction of the airway by the hypo-pharyngeal tissue as you can see in Figures 1.2 and 1.3.

Figure 1.2: Anatomic Obstruction



Figure 1.3: Releiving Anatomic obstruction



Chin lift and head tilt

Place your hand on the child's forehead and apply a little pressure to achieve the tilt. The fingers of the other hand are used to gently lift the chin. The drawings illustrate two different positions. Figure 1.4 shows the position for infants, the nose pointing upwards. Figure 1.5 shows the position for children, the chin pointing up. Use it only for patients without trauma or suspected trauma.



Figure 1.4: Neutral position to open the airway in an infant



Figure 1.5: Sniffing position to open the airway in an older child ("chin-up")

Jaw trust

To open and manage the airway when trauma is suspected, a jaw thrust is used, as illustrated in Figure 1.6.



Figure 1.6: Jaw thrust technique to open the airway

This is a way of opening the airway without moving the head. It is safe to use in cases of trauma for children of all ages. The Jaw thrust is achieved by placing two or three fingers under the angle of the jaw on both sides, and lifting the jaw upwards. If a child has trauma you must avoid further injury during assessment or treatment. This child may have a spinal injury, which could be made worse by moving him. Therefore, stabilization of the head and neck should be performed for all patients with suspected trauma of the head and neck. (See Figure 1.7)

To check for head or neck trauma:

- Ask if the child has had trauma to the head or neck or a fall which could have damaged the spine
- Look for bruises or other signs of head or neck trauma

To stabilize the neck:

Keep the child lying on his/her back

- Prevent the neck from moving by supporting the child's head with a cervical collar or using other materials (e.g. liter bags of IV fluid on each side)
- Tape the child's forehead to the sides of a firm board to secure this position
- Place a strap over the chin

If the child is vomiting, turn them on their side, keeping the head in line with the body (log roll maneuver, See Figure 1.8). If the child is restless, ask an attendant to stabilize the neck without upsetting the child more.



Figure 1.7: Stabilizing the neck when trauma is suspected

Log roll

This maneuver is used when a patient's body needs to be moved while still providing stability to the neck. Move a patient with a suspected cervical spine injury carefully. Avoid rotation and extremes of flexion and extension. One person, usually the most senior attendant, should assume responsibility for the neck. He or she should stand at the head of the bed, hold the patient's head, place their fingers under the angle of the mandible with the palm over the ears and parietal region, and maintain gentle traction to keep the neck straight and in line with the body (see Figure 1.8).

When the patient is not being moved, a sandbag placed on each side or a cervical collar can splint the neck.

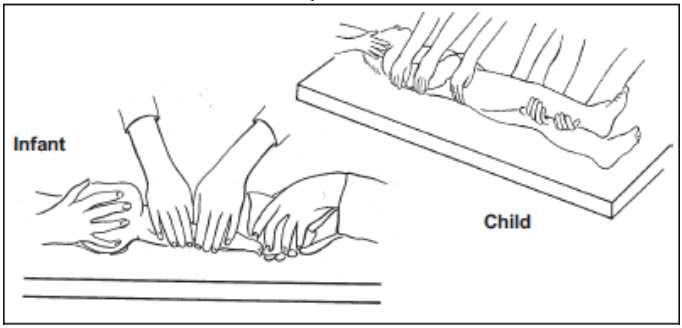


Figure 1.8: Log roll: stabilizing the neck of the patient while moving the body

Additional methods for maintaining anatomic airway

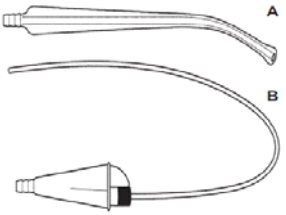
The occiput is prominent in neonates and in young infants and during supine flexion of the neck, partial obstruction of the airway may occur. Putting a small towel roll placed under the shoulder could help infants to open the airway. Similarly putting towel under the neck and head for older children helps to open the airway.

Clearing the airway

Besides manual opening of the airway, suction of secretions, mucus, or blood from the mouth may be necessary to re-establish airway patency. It aids in the clearance of liquid and particulate material. An example of a common suction device is seen in Figure 1.9.

Appropriate size catheter is required. Excessively deep suctioning of any patient should be avoided to minimize the risk of vomiting, aspiration, laryngospasm, or bradycardia.

Figure 1.9: Yankauer catheter (A) and suction catheter (B) for clearing secretions from the airway



If vomiting occurs, the child's head is first turned to one side, and suctioning is continued until the emesis is cleared. This procedure is done once we are sure that the child is not having cervical cord injury which may be aggravated by the movement.

Insertion of an Oropharyngeal (Guedel) Airway

The oropharyngeal airway can be used in an unconscious patient to improve airway opening. It may not be tolerated in a patient who is awake and may induce choking or vomiting. Guedel airways come in different sizes (see Figure 1.10). An appropriate sized airway goes from the centre of the teeth (incisors) to the angle of the jaw (see Figure 1.11).

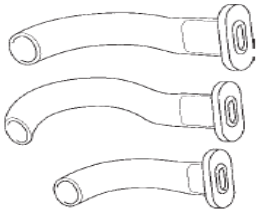


Figure 1.10: Guedel tubes of different sizes and types

Infant:

- Select an appropriate sized airway
- Position the child to open the airway, taking care not to move the neck if trauma suspected
- Using a tongue depressor, insert the oropharyngeal airway, the convex side up (Fig 1.12)
- Re-check airway opening
- Use a different sized airway or reposition if necessary
- Give oxygen



Figure 1.11: Selecting the right size of an oropharyngeal airway

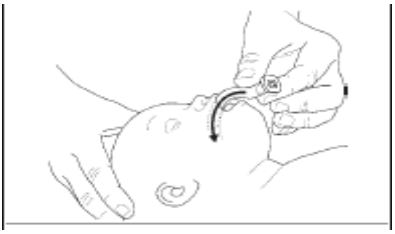


Figure 1.12: Inserting an oropharyngeal airway in an infant: convex side up

Child

- Select an appropriate sized oropharyngeal airway.
- Open the child's airway, taking care not to move the neck if trauma suspected.
- Using a tongue depressor, insert the airway "upside down" (concave side up) until the tip reaches the soft palate.
- Rotate through 180° and slide back over the tongue. (Figure 1.13)
- Recheck airway opening.
- Use a different sized airway or re-position if necessary.
- Give oxygen.

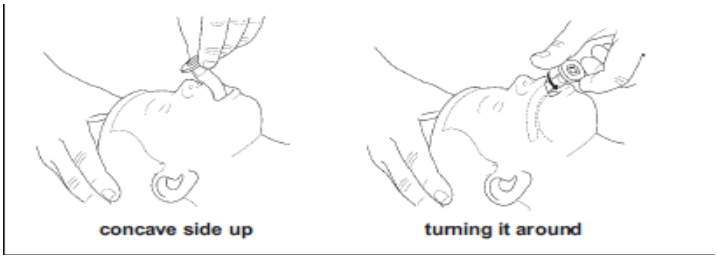


Figure 1.13: Inserting an oropharyngeal airway in an older child; concave side up and turning it around

Management of foreign body aspiration (a choking child)

Ask the child's caretaker explicitly for a history of choking. Techniques to remove foreign bodies are based on support of forced expiration rather than a blind finger sweep of the mouth or mechanical removal of the object. A blind finger sweep in infants and children should not be done, as it might cause serious bleeding. Attempts to force the foreign body out of

the airway should be done immediately, because airflow may be halted completely and sudden death could be imminent.

A child with a history of aspiration of a foreign body who shows increasing respiratory distress is in immediate danger of choking. Attempts to remove the foreign body should be made instantly. Do not hesitate. If a foreign body is causing the obstruction, the treatment depends on the age of the child.

Management of young infant with foreign body aspiration

- Lay the infant on your arm or thigh in a head down position
- Give 5 blows to the infant's back with heel of hand.
- If obstruction persists, turn infant over and give 5 chest thrusts with 2 fingers, one finger breadth below nipple level in midline.
- If obstruction persists, check infant's mouth for any obstruction which can be removed
- If necessary, repeat sequence with back slaps again.

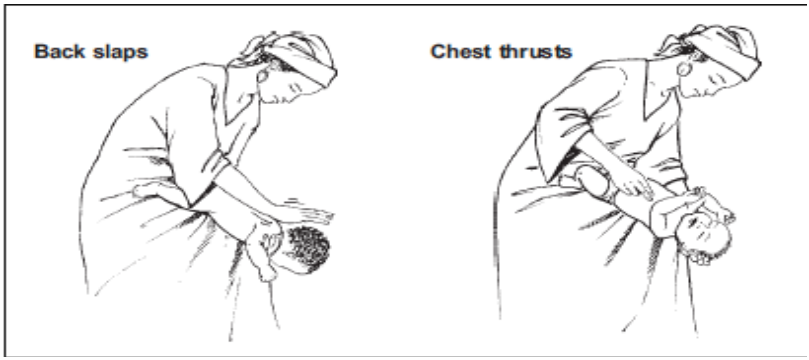


Figure 1.14: Management of young infant with foreign body aspiration

Management of a child with foreign body aspiration

- Give 5 blows to the child's back with heel of hand with child sitting, kneeling or lying
- If the obstruction persists, go behind the child and pass your arms around the child's body; form a fist with one hand immediately below the child's sternum; place the other hand over the fist and pull upwards into the abdomen; repeat this Heimlich maneuver 5 times
- If the obstruction persists, check the child's mouth for any obstruction which can be removed.
- If necessary, repeat this sequence with back slaps again.

After you have performed this procedure, you should check inside the mouth for any foreign body. Obvious foreign bodies should be removed. The breathing should be checked again. If these maneuvers are unsuccessful or if the child becomes unconscious, start bag and mask ventilation. If available, laryngoscopy with direct visualization can remove the foreign body with a forceps.

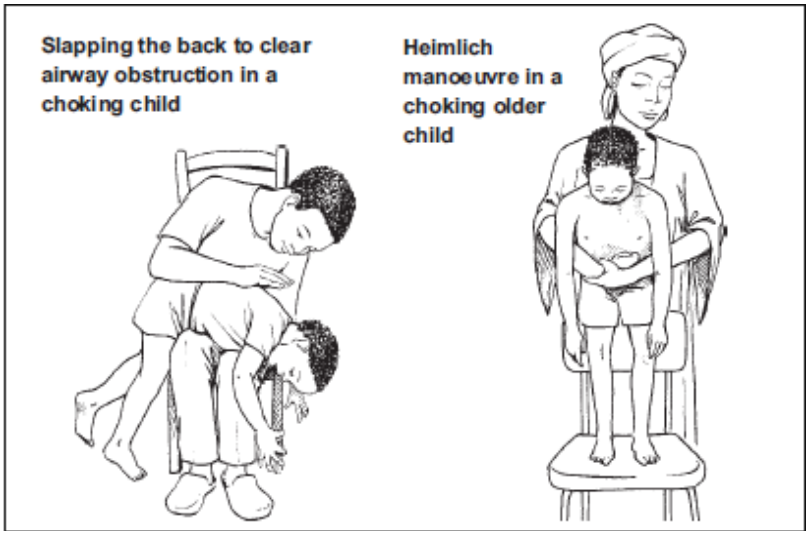


Figure 1.15: Management of child with foreign body aspiration

Advanced Intervention

This is done in a setting where experts are available
1. Endotracheal intubation
2. Removal of foreign body with direct visualization by laryngoscope
3. Application of positive airway pressure (CPAP)
4. Cricothyroidotomy

If the airway obstruction is due to anaphylaxis (patients with urticaria, swelling of the lips and face, change of voice, cough, wheeze and dyspnea) manage airway, give adrenaline and other management for anaphylaxis.

Management of breathing problem

1. Bag and mask ventilation

2. Give oxygen by different ways depending on the child's condition

3. Thoracentesis and or tube thoracostomy

Proper Technique for Bag-Mask Ventilation

- It is important for the mask to be the correct size for the child
- The correct size and position are shown in the illustration (see Figure 1.16).
- The mask should also be placed correctly over the face in order to prevent leakage. The mask should cover both the entire mouth as well as both nostrils.
- To ensure a proper seal around the mask, use the C-E technique. This involves making a C-shape using your thumb and index finger around the base of the mask and press down onto the face. At the same time, use your 3rd-5th digits and place them along the edge of the jaw in the shape of inverted E and elevate the mandible anteriorly. (see Figure 1.17 & 1.18)
- If oxygen is available, connect it to the bag-mask
- When providing bag-mask ventilation, ensure for chest rise or auscultation of breath sounds
- Ventilate the child with a rate of 40-60/min for neonate, 20/min for infant and 12-15 breath per minute for child
- Do not hyperventilate and avoid pressure over the mask
- If chest rise is not visible, common problems include poor mask seal around the face, airway obstruction due to improper airway positioning, or excessive secretions requiring suctioning

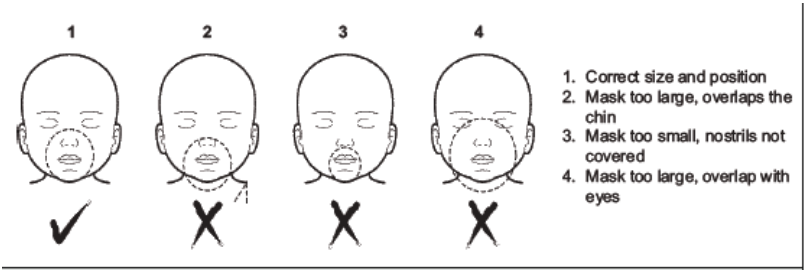


Figure 1.16: Choosing the right mask size



Figure 1.17: One person bag mask demonstrating C-E techniques



Figure 1.18: Two person bag mask technique

Give Oxygen to treat hypoxemia

There are two possible sources of oxygen: oxygen concentrators and oxygen-filled cylinders (see Figure 1.19 and 1.20)



Figure 1.19: Oxygen concentrator



Figure 1.20: Oxygen Cylinder

Oxygen Delivery

Two methods are recommended for the delivery of oxygen in an emergency setting: nasal prongs and nasal catheter. Nasal prongs are best for delivering oxygen to young infants and children with severe croup or pertussis; do not use nasal catheters as they provoke paroxysms of coughing. Set a flow rate of 0.5-1 liters/min in infants and 1-2 litres/min if

older in order to deliver 30-35% oxygen concentration in the inspired air. **Face Mask**: an alternative method in emergency settings is the use of a face mask, which requires higher flow rates (6-10 liters/ minute). It is therefore not suitable for permanent oxygen delivery, and is reserved for serious emergency.

1.3 Circulation

The letter C in "ABCDO" stands for assessment and management of **C**irculation, **C**oma and **C**onvulsions.

Assess the circulation

To assess if a child has a circulation problem you should know:

- Does the child have warm hands?
- If not, is the capillary refill time ≥ 3 seconds?
- And is the pulse weak and fast?

Table 1.3: Assessment and treatment of circulation

C **CIRCULATION**	Cold hands with: ▪ Capillary refill ≥ 3 seconds, and ▪ Weak and fast pulse	Signs Positive Check for severe malnutrition	▪ Stop any bleeding ▪ Give oxygen ▪ Make sure the child is warm IF NO SEVERE MALNUTRITION: ▪ Insert IV and begin giving fluids rapidly ▪ If not able to insert peripheral IV, insert an intra- osseous line or external jugular IF SEVERE MALNUTRITION: ▪ Give IV glucose ▪ Proceed immediately to full assessment and treatment
Check for head/neck trauma before treating the child; do not move the neck if cervical spine injury is possible.			

Is the Pulse Weak and Fast?



Figure 1.21: Feeling the brachial pulse in an infant

Shock

The most common cause of shock in children is loss of fluid from circulation, either through loss from the body as in severe diarrhea or when the child is bleeding, or through capillary leak in a disease such as severe sepsis or burn. In all cases, it is important to replace this fluid quickly (as shown in Chart 5).

If the child has severe malnutrition, you must use a different fluid and a different rate of administration and monitor the child very closely.

Treatment of Shock

The following actions need to be started simultaneously:

- If the child has any bleeding, apply pressure to stop the bleeding
- Give oxygen
- Make sure the child is warm
- Select an appropriate site for administration of fluids
- Establish IV or interosseous access
- Take blood samples for emergency laboratory tests
- Begin giving fluids for shock.

Stop any bleeding

The best and safest way to stop bleeding is to apply firm and direct pressure to the point that is bleeding with a gloved hand. Do not use a tourniquet.

Give oxygen

All children who are in shock require oxygen. It can be given in any of the ways discussed in the previous section.

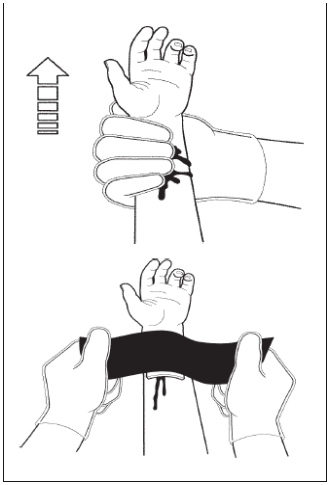


Figure 1.22: Controlling external bleeding

Make sure the child is warm

This should be done by ensuring that the child is dry and covered with blankets or warm clothing.

Select an appropriate site for administration of fluids

The most appropriate route for administration is intravenous and a peripheral vein is preferable but not always accessible. Alternatives are interosseous (IO) infusion or a central vein catheter.

Give Intravenous Fluids

First assess the child for severe malnutrition before selecting treatment as shown on Chart 5 (refer chapter 7 for assessment of malnutrition). The severely malnourished child is considered to have shock if he/she is lethargic or unconscious and has cold hands plus either:

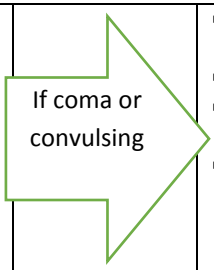
- Slow capillary refill (≥ 3 seconds), or
- Weak, fast or absent radial or femoral pulses and
- Absence of signs of heart failure in an edematous child

Table 1.4: Treatment of shock	
If the child has NO severe Acute Malnutrition	If the child HAS Severe Acute Malnutrition
▪ Insert an intravenous line (and draw blood for emergency laboratory investigations). ▪ Fix the cannula and immobilize the extremity with a splint. ▪ Attach Ringer's lactate or normal saline - make sure the infusion is running well. ▪ Infuse 20 ml/kg as rapidly as possible. ▪ The circulation should be reassessed as described before. ▪ **Improvement**: warmer hands, pulse slows and capillary refill faster. ▪ **If there is NO improvement**: ▪ Give another 20 ml/kg of Ringer's lactate or normal saline as quickly as possible. Reassess the circulation again, and if there is still no improvement, ▪ Give another 20 ml/kg of Ringer's lactate or normal saline, as quickly as possible. The circulation should be assessed again. ▪ **If there is still NO improvement:** ▪ Consider Blood Transfusion unless there is profuse watery diarrhoea. In this case, repeat Ringer's lactate. ▪ The circulation should be assessed again. ▪ **If there is still NO improvement:** ▪ See inpatient treatment guidelines for underlying condition	▪ Weigh the child. ▪ IV Fluid (15ml/kg over 1hr) ▪ Fix the cannula and immobilize the extremity with a splint. ▪ Give normal saline or Ringer lactate with 5% glucose at 15 ml/kg given over 1 hour (if available use half strength Darow's solution with 5% glucose) ▪ Stay with the child and check the pulse and breathing rate every 5-10 minutes. ▪ Discontinue the intravenous infusion if either of these increases (pulse by 15, respiratory rate by 5/ min). ▪ If the child improved, change the IV fluid with oral intake/ Resomal after 2 hrs **If there IS improvement:** (pulse and breathing rate fall) ▪ Repeat 15ml/kg over 1 hour. **If there is NO improvement:** ▪ Call senior health worker. ▪ Give maintenance IV fluid 4ml/kg/hour while waiting for blood. ▪ Transfuse fresh whole blood at 10ml/kg slowly over 3 hours (use packed cells if in cardiac failure). ▪ Follow National Guideline for Management of SAM

Assessment and management of Coma and Convulsion

To assess the child's neurological status you need to know:

- Is the child in coma?
- Is the child convulsing?

Table 1.5: Assessment and treatment of coma and convulsion			
Cm COMA **Cn** CONVULSION	Coma or Convulsing (now)		▪ Manage the airway ▪ Give oxygen ▪ If convulsing, give diazepam rectally ▪ Position the child (if head or neck trauma is suspected, stabilize the neck first) ▪ Give IV glucose

Consciousness level of a child should be assessed using a simple AVPU scale.

A Is the child Alert? If not,

V Is the child responding to Voice? If not,

P Is the child responding to Pain?

U The child who is Unresponsive to Voice (or being shaken) and to pain is Unconscious.

Initial assessment of level of consciousness should be done by AVPU. Using Glasgow Coma Scale (GSC) is time taking for the initial assessment but can be used for follow up of the child's progress.

Table 1.6: Glasgow Coma Scale			
	Child		Infant
Eye Opening (E)	Spontaneous To speech To pain None	4 3 2 1	Spontaneous To speech To pain None
Verbal (V)	Oriented Confused Inappropriate Incomprehensible None	5 4 3 2 1	NoneCoos/Babbles Irritable Cry Cries/Pain Moans None
Motor (M)	Obeys commands Purposeful Withdrawals(pain) Flexion(pain) Extension(pain) None	6 5 4 3 2 1	Spontaneous Withdraws(touch) Withdraws (pain) Abnormal flexion Abnormal Extension NoneSpontaneous

Treatment of coma and convulsion

Treatment of coma and convulsions has some similarities and will be described together.

Table 1.7: Treatment of coma and convulsion	
COMA	CONVULSION
If the child is unconscious you should: ▪ Manage the airway ▪ Position the child (if there is a history of trauma, stabilize neck first) ▪ Check blood sugar ▪ Give IV glucose	If the child is convulsing now you should: ▪ Manage the airway ▪ Position the child ▪ Check the blood sugar ▪ Give IV glucose ▪ Give anticonvulsant

Position the Child

Coma

Any unconscious child who is breathing and keeping the airway open should be placed in the recovery postion. This position helps to reduce the risk of vomit entering the child's lungs (see Figure 1.23). It should only be used in children who have not been subjected to trauma.



Figure 1.23: Positioning the unconscious child (recovery position)

If neck trauma is not suspected:

- Turn the child on the side to reduce risk of aspiration
- Keep the neck slightly extended and stabilize by placing the cheek on one hand
- Bend one leg to stabilize the body position

If trauma is suspected:

- Stabilize neck and turn the child to the side using log roll method.

If the child is having a convulsion, do not attempt to hold him/her down or put anything in the child's mouth. If the child vomits turn the child on his/her side to avoid aspiration. If the convulsion has stopped and the airway is clear, the child can be placed in the recovery position (see Figure 1:23).

Check the Blood Sugar

Coma and convulsion

Hypoglycemia is present if the measured blood glucose level is low <2.5 mmol/l (45 mg/dl) in a well nourished or <3 mmol/liter (54 mg/dl) in a severely malnourished child.

When the blood glucose cannot be measured, hypoglycaemia should be assumed to be present in all children in coma or having a convulsion and should be treated.

Give IV Glucose

Coma and convulsion

- Insert an IV line and draw blood for emergency laboratory investigations.
- Give 5 ml/kg of 10% glucose solution rapidly by IV infusion
- Recheck the blood glucose in 30 minutes. If it is still low, repeat 5 ml/kg of 10% glucose solution.
- Feed the child as soon as conscious.

If the child is not able to feed and there is a danger of aspiration, give:

- Milk or sugar solution via nasogastric tube.
- Maintenance IV fluid containing 5-10% glucose (dextrose)
- To make sugar solution, dissolve four level teaspoons of sugar (20 grams) in a 200-ml cup of clean water.

Table 1.8: Amount of glucose to give by age			
Age/weight	Volume of 10% glucose solution to be given as bolus (5 ml/kg)	To make up 10% glucose using 40% glucose solution	
		Volume of 40% glucose	Volume of normal saline
Less than 2 months (<4 kg) 2 - <4 months (4 - <6 kg) 4 - <12 months (6 - <10 kg) 1 - <3 years (10 - <14 kg) 3 - <5 years (14 - <19 kg)	15 ml 25 ml 40 ml 60 ml 80 ml	4 ml 6 ml 10 ml 15 ml 20 ml	11ml 19ml 30ml 45ml 60ml
Note: If you have a 50% glucose solution; to make it 10% use 1 part 50% to 4 parts of normal saline or sterile water. 10% solution can also be prepared from 85% of 5% DW and 15% of 40% DW of the calculated volume.			

Give an Anticonvulsant

Diazepam is the first drug to use if the child is convulsing in front of you. No drug should be given if the convulsion has stopped. Diazepam can be given by the rectal or intravenous route. Rectal diazepam acts within 2 to 4 minutes. In an emergency, it is easier and quicker to give it rectally than intravenously, unless an intravenous line is already running. The dose is 0.5mg/kg (0.1 ml/kg) rectally or 0.25mg/kg (0.05 ml/kg) intravenously. Estimated doses of rectal diazepam, lorazepam and midazolam are shown in Table 1.9 below.

Draw up the dose from an ampoule of diazepam into a tuberculin (1 ml) syringe. Then remove the needle. Insert the syringe 4 to 5 cm (about the length of your little finger) into the rectum and inject the diazepam solution. Hold the buttocks together for a few minutes. If you already have intravenous access, you can give the correct volume of drug directly, but slowly, in at least one full minute. Reassess the child after 10 minutes.

If still convulsing, give a second dose of diazepam, rectally or, even better, give lorazepam (or diazepam intravenously slowly over 1 minute if an IV infusion is running). If the convulsion continues in spite of this second dose, consider giving phenytoin 20mg/kg IV/IO over 20 min (1mg/kg/min)

monitor heart rate for arrhythmia. Alternatively phenobarbital 15-20 mg /kg IV or intraousues can be used if phenoytoin not available

Table 1.9: Diazepam, lorazepam and midazolam dosages by weight/ age for the treatment of convulsions

Weight/Age	Diazepam		Lorazepam	Midazolam	
	Diazepam given rectally (10 mg/2ml solution) Dose 0.1ml/kg	Diazepam given IV (10 mg/2ml solution) Dose 0.05ml/kg	IV/ Buccal (4mg/ml ampoule) 0.1mg/kg (0.025ml/kg)	IV (5mg/5ml ampoule) 0.25mg/kg (0.25ml/kg)	Buccal (5mg/1ml)0.5mg/kg Volume=0.25ml/kg
4 kg (<2 mon)	0.4ml	2ml	0.1ml	1ml	0.2ml
6 kg (2-6mon)	0.6ml	0.3ml	0.15ml	1.5ml	0.3ml
8 kg (6-8mon)	0.8ml	0.4ml	0.2ml	2ml	0.4ml
10 kg (8-10 mon)	1ml	0.5ml	0.25ml	2.5ml	0.5ml
12 kg (10-12 mo)	1.2ml	0.6ml	0.3ml	3ml	0.6ml
14 kg (1-3yrs)	1.4ml	0.7ml	0.35ml	3.5ml	0.7ml
16 kg (4-5yrs)	1.6ml	0.8ml	0.4ml	4ml	0.8ml
18 kg (5-6yrs)	1.8ml	0.9ml	0.45ml	4.5ml	0.9ml
20 kg (6-7yrs)	2ml	1ml	0.5ml	5ml	1ml

Diazepam and phenobarbital can affect the child's breathing; it is important to reassess the airway and breathing regularly and a bag and mask should be ready.

Table 1.10: Dose of phenobarbital for young infants (phenobarbital 200mg/ml solution)

Weight of infant	2 kg or less	2-3 kg
Loading dose of phenobarbital, 20mg/kg,	0.2 ml	0.3 ml
Reload if convulsions continue with 10mg/kg	0.1 ml	0.15 ml

If there is high fever:

- Sponge the child with room-temperature water to reduce the fever.
- Do not give oral medication until the convulsion has been controlled (danger of aspiration).

1.4 Dehydration

The letter D in the ABCDO stands for Dehydration. These assessments can take place if those for A, B, and C were all normal, or if emergency treatments have been given for any problem encountered. If there are no signs of dehydration, you can move on to look for other emergency signs and then for priority signs (for assessment and management of dehydration refer to chapter 5).

1.5 Cardiopulmonary Resuscitation (CPR)

The most important action of preventing death due to cardiac arrest is anticipation and prevention of the occurrence of cardiac arrest by intervening when a child manifests in respiratory distress or early stages of shock.

Step 1: Check patient responsiveness

- Attempt to rouse the patient with verbal or painful stimuli
- If no response, assume that the brain is no longer receiving adequate oxygen and continue down management pathway for cardiac arrest

Step 2: Assessment and management of airway

- To assess for a patent airway, use the look/listen/feel approach:

Step 3: Giving rescue breaths

If the airway is patent and spontaneous respiration is not observed or the child is not breathing adequately, then artificial ventilation should be initiated.

- Using a bag mask device, give 2 breaths in quick succession and observe for chest rise (Figure 1.24).
- If bag mask is not available, perform mouth-to-barrier using a plastic barrier device (Figure 1.25).

- You should be able to observe chest rise with these breaths. If no chest rise is seen, reposition the head and re-attempt breaths.

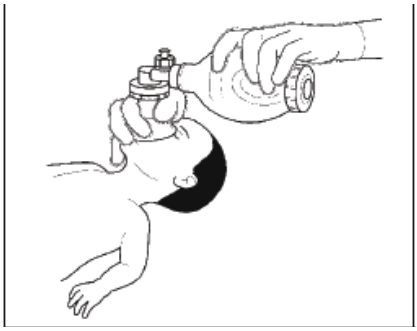


Figure 1.24: Bag mask technique



Figure 1.25: Mouth to barrier device to give rescue breath

- After two breaths are delivered, assess for a pulse.
- In an infant or small child, the pulse should be palpated in the brachial artery. In an older child, the carotid or radial artery may be assessed.
- If no pulse is felt after 10 seconds, chest compressions should be initiated.

Step 4: Chest compressions

- To find the correct hand position in an older child, palpate the xiphoid process and place hands directly above this area on the sternum.
- In older children, place one hand on top of the other and push down onto the chest, making sure to keep your shoulders directly over your hands and elbows remain locked (Fig 1.26).
- In younger children (<8 years old), hand position is the same as an older child although only 1 hand is needed for compressions (Figure 1.27).
- In infants, use 2 fingers in the center of the chest just below the nipples in one rescuer (Figure 1.28). In the presence of two rescuers, incircling method is preferable (Figure 1.29).
- The basic principle behind high-quality CPR is that adequate chest compressions are performed.

- The key to adequate compressions is as follows:
    - Push fast (rate of 100/min)
    - Push hard (about 1/3 to 1/2 of antro-posterior chest diameter)
    - Allow for full chest recoil in between compression and minimize interruptions
    - Rotate rescuers ever 2 minutes or sooner when tired (see the algorithm for the basic principle of CPR).

Deciding to Terminate Resuscitative Efforts

In the majority of situations, prolonged resuscitative efforts for children are unlikely to be successful and can be discontinued if there is no return of spontaneous breathing after 20 minutes of proper CPR.



Figure 1.26: Hand placement in an older child



Figure 1.27: Hand placement in a younger child

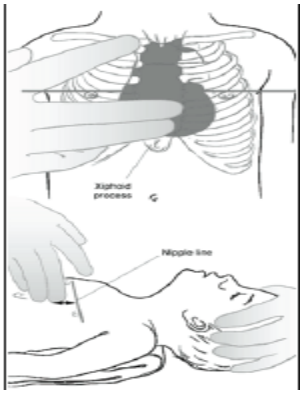


Figure 1.28: Hand placement in an infant (one rescuer)



Figure 1.29: Incircling method (two rescuers)

Neonatal resuscitation

Most babies require basic essential newborn care at and after delivery. Only few need extra support and resuscitation (see chapter 3).

Common Respiratory Emergencies in Children

Common respiratory emergencies include pneumonia, croup, asthma, foreign body aspiration and retropharyngeal abscess (refere to chapter 4 for assessment and management of specific conditions)

1.6 Pediatric Trauma

Evaluation of trauma patients

In evaluating trauma patients, a standardized systemic approach reduces morbidity and mortality. The steps are as follows:

- Primary survey (rapid primary evaluation) and resuscitation of vital functions; this is usually done simultaneously.
- Utilization of adjuncts to the primary survey and resuscitation
- Secondary survey (detailed history and head to toe examination)
- Transition to definitive care

Primary survey

Identify and treat immediate life threatening conditions. This should be performed in a stepwise approach as follows:

A	Airway maintenance with cervical spine protection
B	Breathing and ventilation
C	Circulation with hemorrhage control
Ds	Disability (evaluation of neurologic status)
O/E	Exposure and environmental control

Adjuncts to primary survey:

- Consider laboratory studies that need to be done – Hct/Hgb, blood group and Rh, random blood sugar, urinalysis to look for hematuria, and liver enzymes (raised liver enzymes may indicate intrabdominal liver injury)
- Urinary catheter should be placed to monitor urine output as well as an NG tube (children's stomachs should be assumed to be full)
- If bedside ultrasound is available, consider performing FAST (Focused Assessment with Sonography for Trauma) exam to assess for conditions such as intrabdominal bleeding or cardiac tamponade

Secondary survey

Should include a complete head to toe evaluation including:

- history
- complete examination
- laboratory studies
- radiographic studies
- problem identification

Use the mnemonic 'AMPLE' to assist in taking history in trauma patients

A	Allergies
M	Medications
P	Past medical and surgical history
L	Time of the child's last meal
E	Events preceding the accident

For further assessment and management of specific trauma, refere to chapter 9.

1.7 Burn Injury

Burn injury is one of the common injuries in children accompanied by high risk of mortality and morbidity. The morbidity includes: acute life-threatening complications (fluid loss, blood loss, airway obstruction, renal failure, and superinfection) and chronic complications (significant disfigurement, disability and psychological trauma).

Emergency treatment of burn injury

- Cool the burn area with cold tap water within 30 min for 20 min this stops the heat as well as decreases the progression of burn, but avoid it for large area burn as it increases the risk of hypothermia. Use of ice should also be avoided.
- Similarly don't use grease (e.g. butter, oil) since it predisposes for infection and doesn't disperse heat. If the burn is caused by hot tar, use mineral oil to remove the tar.
- Remove all clothing and jewelry – especially rings.

Airway & Breathing

- Manage as trauma patient. Since the airway swelling increases in the next 24 hours, there is a need of early advanced airway management (intubation or tracheotomy).
- Administer 100% oxygen to displace carbon monoxide during inhalational burn

Circulation

- Shock is common in children with burns that involve more than 10% to 12% of the total body surface area.
- Secure urgently an IV line for burns of ≥10% of Body Surface Area (BSA), for all inhalation and electric burns. If possible, IV line should be on the intact skin but access through burned areas may be secured. If IV couldn't be found, use intra-osseous route.

- Don’t put adhesive plaster circumferentially to the body as it can cause circulatory insufficiency.
- For children with severe burn (≥ 20% TBSA) give 20 mL per kg of crystalloids till assessment of the extent of the burns and calculation of the rest of the fluid of the 24 hours is completed.
- For most children the Parkland formula is an appropriate starting guideline for fluid resuscitation (4 mL lactated Ringer/kg/% BSA burned) in addition to the patient's calculated maintenance fluids after the 1st bolus is subtracted. Half of the fluid is given in the first 8 hours of the resuscitation and the remaining half over the next 16 hours.
- Children younger than 5 yrs of age require the addition of 5% dextrose in the first 24 hr of resuscitation
- Additional fluids may also be necessary when burns are associated with an inhalation injury, fractures or other traumatic lesions causing blood loss.
- If patients are not alert and oriented, consider: associated injuries such as : carbon monoxide (CO) poisoning, inhalation injury, hypoxia and preexisting medical condition

Indication for Hospital Admission

- burn is >10% of their body
- Burns over Face ,neck ,hands ,feet ,perineum ,or joint ,
- Circumferential burns
- inhalational and high tension electric burns
- suspected child abuse

See chaper 9 for further assessment and subsequent management.

1.8 Common Childhood Poisoning

Suspect poisoning in any unexplained illness in a previously healthy child.

If the child arrives within 1 hour of ingestion of poisons, he/she will be managed as an emergency because this needs urgent treatment.

Primary survey: Assess ABCDO with additional consideration of the poisoning agent

Airway: Remove excessive secretions; look for any inhalational injury that might potentially worsen with time. Check for signs of burns in or around the mouth or of stridor (upper airway/laryngeal damage) suggesting ingestion of corrosives. Consider consultation for early intubation, if the patient has severe airway compromise.

Breathing: Look for signs of respiratory distress and give oxygen if indicated

Circulation: Check the pulse, capillary refill and skin color. If there is shock treat accordingly

Coma: check the AVPU and pupillary response

- Determine blood sugar and give Dextrose if hypoglycemic or if the child has reduced level of consciousness, treat as if hypoglycemic.

Dehydration: Assess hydration status (dry tongue, buccal mucosa and sunken eyeball)

Exposure: Remove all clothing and wash with soap and water and check body temperature

Secondary survey: more specific evaluation with history and physical examination and laboratory to identify the exact cause and extent with simultaneous detoxification of the patient.

History and physical examination

History

- Find out full details of the poisoning agent
- Attempt to identify the exact agent involved requesting to see the container, where relevant
- Try to find the best estimate of the agent dose or amount (keep in mind one pill can kill)
- The route of exposure (inhalation, injection, ingestion, contact)

- The time of ingestion to presentation (important for the management of the child)
- Check that no other children were involved

Physical exam

Do detailed examination which help to identify the causes: breath odor, temperature, eye sign (dilated vs constricted pupil), skin (hot flushed, dry) and bowel sound.

General Principles of Management

Management of a child with acute poisoning includes four principles:

- Decontamination (GI, skin, eye)
- Enhancing elimination
- Giving antidote and
- Supportive care

Gastrointestinal decontamination

This is most effective if done within one hour of ingestion, and after this time there is usually little benefit, except with agents that delay gastric emptying, sustained release preparations and massive pill ingestions.

Methods of gastrointestinal tract (GIT) decontamination includes ipecac induced vomiting, use of cathartics, gastric lavage, activated charcoal and whole bowel irrigation (WBI)

Syrup of ipecac and cathartics are not recommended to manage children with acute poisoning.

Gastric emptying with lavage

Gastric lavage is useful only if it is done within one hour of ingestion of poisons (especially liquid).

During the procedure:

- Make sure a suction apparatus is available in case the child vomits.
- Place the child in the left lateral/ head down position.

- Measure the length of tube to be inserted.
- Pass a 24–28 French gauge tube through the mouth into the stomach (as a smaller size nasogastric tube is not sufficient to let particles such as tablets pass)
- Ensure the tube is in the stomach by aspiration
- Perform lavage with 15 ml/kg/cycle body weight of normal saline (0.9%) maximum 200 to 400ml
- The volume of lavage fluid returned should approximate to the amount of fluid given
- Lavage should be continued until the recovered lavage solution is clear of particulate matter.

Contraindications to gastric lavage are:

- Ingestion of corrosives or petroleum products
- unconscious child with unprotected airway

Activated Charcoal

- It is more effective if used with in 1 hour but may be given as late as 4 hours if the toxic agent causes delayed intestinal movement
- The usual dose of activated charcoal is 1 g per kg; adolescents should receive maximum of 50 g
- The amount of water is 8-10 times the amount of the charcoal, e.g. 5 g in 40 ml of water
- If possible, give the whole amount at once; if the child has difficulty in tolerating it, the charcoal dose can be divided.
- It can be mixed with caffeine free diet cola or juice to improve the child's intake
- Don't force the child, you can insert NG tube to facilitate intake

Toxins poorly or not adsorbed by charcoal are:

- Caustics (alkali and acids)
- hydrocarbons
- alcohol
- heavy metals (lead)
- iron and lithium

Whole Bowel Irrigation (WBI)

- WBI is administration of large volume of polyethylene glycol solution with balanced electrolyte.
- Usually given by NGT
- Effective after ingestion of slowly absorbed substances, substances poorly adsorbed to activated charcoal (lithium, iron) and pills
- For children 35ml/kg/hr can be given and adolescents can take 1-2 lts per hour

Skin Decontamination

- Remove all clothing and personal effects and thoroughly clean all exposed areas with copious amounts of tepid water.
- Use soap and water for oily substances.
- Attending staff should take care to protect themselves from secondary contamination by wearing gloves and apron.
- Removed clothing and personal effects should be stored safely in a see through plastic bag that can be sealed, for later cleansing or disposal.

Eye Decontamination

- Rinse the eye for 10–15 minutes with clean running water or saline, taking care that the run-off does not enter the other eye by lying on the side and running into the inner canthus and out of the outer canthus.
- Evert the eyelids and ensure that all surfaces are rinsed.
- Where possible, the eye should be thoroughly examined under fluorescein staining for signs of corneal damage.
- If there is significant conjunctival or corneal damage, the child should be seen urgently by an ophthalmologist.

Decontamination for Inhaled Poisons

- Remove from the source of exposure.
- Urgently call for help
- Administer supplemental oxygen, if there is respiratory distress or cyanosis or oxygen saturation ≤90%
- Inhalation of poisonous gases may cause swelling and upper airway obstruction, bronchospasm and delayed pneumonitis

Multiple-Dose Activated Charcoal

- This method enhances poison elimination by interfering with enterohepatic recirculation GI dialysis
- Give 0.25 to 0.5 g/kg every 3 to 4 hour until the patient's condition improves
- Considered in drug poising including phenobarbital, carbamazepine, phenytoin, digoxin, salicylates, and theophylline

Further Management of the Poisoned Child

- Give specific antidote if this is available and indicated
- Keep the child under observation for 4–24 hours depending on the poison swallowed
- Keep unconscious children in the recovery position.
- Refer the child to the next level health facility, only when appropriate and where this can be done safely
- If the child is unconscious or has deteriorating conscious level, has burns to mouth and throat, is in severe respiratory distress, is cyanosed or is in heart failure, stabilize him/her before referral

Specific poisons

1. **Corrosive compounds**

- Acid and alkali corrosives are common household agents which cause immediate severe burning of exposed surfaces, usually with intense difficulty of feeding. Eg. sodium hydroxide, potassium hydroxide, acids, bleaches or disinfectants
- Do not induce vomiting or use activated charcoal or gastric lavage when corrosives have been ingested as this may cause further damage to the mouth, throat, airway, lungs, esophagus and stomach.
- Give milk or water within 30 minutes to dilute the corrosive agent. This is only recommended as first aid in mildly symptomatic children.

- In the event of esophageal injury or perforation, fluids may extravasate from the esophagus to the mediastinum.
- Don't try to neutralize with acid/alkaline as this may cause exothermic reaction may occur that also can worsen esophageal injury
- Secure IV line. Do not give anything by mouth and arrange referal for surgical evaluation.

2. Hydrocarbons

These are highly volatile substances which can cause chemical pneumonitis even after ingestion of small volume

E.g. Kerosene, turpentine substitutes, petrol, benzene

Do not induce vomiting or give activated charcoal or gastric lavage as this increases aspiration.

Specific treatment includes oxygen therapy if in respiratory distress, do chest X-ray on presentation and after 6 hours as the first could be normal. If clinically stable after 6 hours consider discharge.

Don't give steroid or prophylactic antibiotic unless the patient develops signs of infections.

3. Organophosphate and carbamate poisoning

- These are commonly used insecticides and herbicides
- Eg. organophosphorus (malathion, parathion, TEPP, mevinphos/Phosdrin and carbamates (methiocarb and carbaryl)
- These compounds can be absorbed through the skin, ingested or inhaled.
- The child may have central nervous system symptoms (dizziness, headache, ataxia, convulsions, and coma)
- Muscarinic effects of these poisons can be memorized with mnemonic "DUMBBELS"
    - Diarrhea
    - Urination
    - Miosis

- Bradycardia
- Bronchorhea
- Emesis
- Lacrimation
- Salivation

Management

- Remove poison by irrigating eye or washing skin (if in eye or on skin)
- Give activated charcoal within 1 hours of ingestion, however it could be given up to 4 hours after ingestion of the poison.
- In a serious ingestion where activated charcoal cannot be given, consider careful aspiration, do gastric lavage (the airway should be protected).
- After decontamination, antidotal therapy begins with administration of atropine sulfate
- Give a dose of 0.05 to 0.1 mg per kg to children and 2 to 5 mg for adolescents IV or IM. This dose should be repeated every 10 to 30 minutes or as needed until chest secretions and pulmonary rales cleared.
- Therapy is continued until all absorbed organophosphate has been metabolized and may require 2 mg to more than 2,000 mg of atropine for a few hours to several days.
- If muscle weakness develops after atropinization, give pralidoxime (cholinesterase reactivator) 25–50mg/kg diluted with 15 ml water by IV infusion over 30 minutes repeated once or twice, or followed by an intravenous infusion of 10 to 20 mg/kg/hour, as necessary.

4. Paracetamol

Paracetamol is administered about 15-20mg/kg/dose and ingestion of 150-200mg/kg will cause toxicity in children

- Give activated charcoal within 4 hours of ingestion
- Decide if antidote is required to prevent liver damage: ingestions of 150 mg/kg or more or toxic 4 hour paracetamol level where this is available.

- Antidote is more often required for older children who deliberately ingest paracetamol or when parents overdose children by mistake.
- If within 8 hours of ingestion give oral methionine or IV acetylcysteine.
- Methionine can be used if the child is conscious and not vomiting (<6 years: 1 gram every 4 hours for 4 doses; 6 years or older: 2.5 grams every 4 hours for 4 doses).
- If more than 8 hours after ingestion, or the child cannot take oral treatment, give IV acetylcysteine.
- For children <20 kg give the loading dose of 150 mg/kg in 3 ml/kg of 5% glucose over 15 minutes, followed by 50 mg/kg in 7 ml/kg of 5% glucose over 4 hours, then 100 mg/kg IV in 14 ml/kg of 5% glucose over 16 hours. The volume of glucose can be scaled up for larger children.
- Continue infusion of acetyl cysteine beyond 20 hours if late presentation or evidence of liver toxicity.
- If liver enzymes can be measured and are elevated, continue IV infusion until enzyme levels are falling.

5. Phenobarbital Poisoning

- Phenobarbital is primarily used as anticonvulsant
- Its overdose results in central nervous system depression with respiratory distress and suppression of skeletal, cardiac and smooth muscles.
- Poisoned child may present with respiratory depression and deranged vital signs (hypotension, bradycardia and hypothermia)
- Pupils may constrict early but dilate later

Management

- Initial management of phenobarbital poisoning is supportive and stabilization of ABCs. Check blood glucose and treat if hypoglycemic
- Give activated charcoal in a dose of 1g/kg for a child (for adolescents give 50g).
- For patients who have a compromised airway, endotracheal intubation is advised prior to giving charcoal.

- With very large overdoses, antecedent gastric lavage may be considered.
- The therapeutic range for phenobarbital is generally considered 15 to 40 µg/ mL.
- Since Phenobarbital undergoes enterohepatic circulation, multiple dose activated charcoal (MDAC) should be given to decrease the half life of the drug and increase its clearance.

6. Carbon Monoxide Poisoning

- Remove patient from the source
- Give 100% oxygen to accelerate removal of carbon monoxide (note patient can look pink but still be hypoxemic) until signs of hypoxia disappear.

7. Snake Bite

Snake bite should be considered in any severe pain or swelling of a limb or in any unexplained illness presenting with bleeding or abnormal neurological signs.

The child may present with local signs or systemic signs

- Local signs include pain, swelling, fang marks, tender lymph node enlargement and local bleeding.
- Initial systemic signs include nausea, vomiting, abdominal pain and headache.
- Specific signs depend on the venom and its effects. These include:
  - Shock, tachycardia, hypotension
  - Signs of neurotoxcity: respiratory difficulty or paralysis, ptosis, bulbar palsy (difficulty swallowing or talking), limb weakness
  - Signs of muscle breakdown: coagulopathy-epistaxis, gum bleeding, bleeding from venipuncture sites, echymosis, bruising, hemoptysis

- Check hemoglobin and if possible, blood clotting should be assessed.

Management

First aid

- Assess and manage the ABCDO of life (includes treatment for shock and respiratory arrest)
- Splint the limb below the level of the heart to reduce movement and absorption of venom
- Apply a firm bandage to affected limb from fingers or toes to proximal of site of bite
- Irrigate and dress the wound
- Avoid cutting the wound or applying tourniquet
- Paralysis of respiratory muscles can last for days and requires intubation and mechanical ventilation or manual ventilation (with a mask or endotracheal tube or tracheostomy ag-valve system) by relays of staff and/or relatives until respiratory function returns.

Antivenom

- If there are systemic signs or severe local signs (swelling of more than half of the limb or severe necrosis), refer the child to hospital where anti-venom is available.
- Prepare IM epinephrine (adrenaline) 10 micrograms/Kg IM (i.e 0.1ml/kg of 1 in 10,000 IM) and IV chlorpheniramine, be ready if allergic reaction occurs
- Give polyvalent anti-venom if the species is not known
- Follow the directions given on the anti-venom preparation
- The dose for children is the same as for adults
- Dilute the anti-venom in 2–3 volumes of 0.9% saline and give intravenously over 1 hour
- Give more slowly initially and monitor closely for anaphylaxis or other serious adverse reactions
- Before you give the anti-venom, perform skin test with 0.02 to 0.03 ml in 1:10 dilution
- If itching/urticarial rash, restlessness, fever, cough or difficult breathing develop, then stop anti-venom and give epinephrine (adrenaline) 10 micrograms/kg

- More anti-venom should be given after 1–2 hr if the patient is continuing to bleed briskly or has deteriorating neurologic or cardiovascular signs.
- Start giving the anti-venom with a minimal dose of 22-40 ml for mild cases and give a maximum of 200-400 ml for severe cases.
- Response of abnormal neurological signs to anti-venom is more variable and depends on type of venom

Surgical Management

- Seek surgical opinion if there is severe swelling in a limb, it is pulseless or painful or there is local necrosis
- Surgical care includes:
  - Excision of dead tissue
  - Incision of fascial membranes to relieve pressure in limb compartments, if necessary
  - Skin grafting, if extensive necrosis
  - Tracheostomy (or endotracheal intubation) if paralysis of muscle involved in swallowing occurs

Supportive care

- Give fluids orally or by NG tube according to daily requirements
- Keep a close record of fluid intake and output.
- Provide adequate pain relief
- Elevate limb if swollen
- Give prophylaxis for tetanus
- Antibiotic treatment is not required unless there is tissue necrosis at wound site
- Avoid intramuscular injections
- Monitor very closely immediately after admission, then hourly for at least 24 hours as envenoming can develop

Drowning

- Initial treatment should be geared towards ensuring adequate airway, breathing, circulation and consciousness (ABCs).
- Check if there are any injuries especially following diving or an accidental fall.
- Facial, head and cervical spine injuries are common.
- Give oxygen and ensure adequate oxygenation

- Remove all wet clothes
- Use nasogastric tube to remove swallowed water and debris from the stomach
- Bronchoscopy for removal of foreign material, such as aspirated debris or vomitus plugs from the airway where necessary
- Warm the child externally if core temperature is > 32^{0} C by using radiant heaters or warmed dry blankets
- If core temperature is < 32^{0}C use warmed IV fluid (39^{0}C) or do gastric/ lavage with warmed 0.9% saline
- Check for hypoglycemia and electrolyte abnormalities especially hyponatremia - this will increase the risk of cerebral edema
- Give antibiotics for possible infection if there are pulmonary signs

CHAPTER 2 - DIAGNOSTIC APPROACHES TO THE SICK CHILD

2.1 Relationship to the IMNCI approach

The pocket book is symptom-based in its approach, with the symptoms following the sequence of the IMNCI guidelines: cough, diarrhea, fever. The diagnoses also closely match the IMNCI classifications, except that the expertise and investigative capabilities that are available in a hospital setting allow classifications like "very severe disease" or "very severe febrile disease" to be defined more precisely making possible such diagnosis as severe pneumonia, severe malaria, septicemia and meningitis. Classifications for conditions such as pneumonia and dehydration follow the same principles as the IMNCI. Young infants (up to 2 months) and severely malnourished children are considered separately (as in the IMNCI approach) because these children require special attention and treatment to reduce the high mortality in the group.

Any critically sick child must be stabilized after brief history and physical examination. In hospital, the stages of management for any child are:

- Emergency triage
- Emergency treatment (if required)
- Taking history
- Physical examination
- laboratory investigations (if required)
- making diagnosis or differential diagnosis
- treatment
- supportive care
- monitoring
- planning discharge
- Follow-up

2.2 Taking history

Taking a history generally starts with understanding the presenting complaint: "Why did you bring the child?" It progresses to the history of the present illness. The symptom-specific chapters give some guidance on

questions that should be asked about symptoms, which help in a differential diagnosis of the illness.

These include personal, vaccination, and family, social and environmental histories. They might lead to important counselling messages, such as sleeping under a bed net for a child with malaria, breastfeeding or sanitary practices for a child with diarrhoea, or reducing exposure to indoor air pollution for a child with pneumonia. In younger infants, the history of pregnancy and birth is important. The feeding history of infants and younger children is essential, as this is often when malnutrition begins. For older children, information on development milestones is important.

Whereas the history is obtained from a parent or caretaker for younger children, older children can contribute important information. You must establish a rapport with the child and the parent before starting the examination. In general, children between the ages of 8 months and 5 years require the most flexible approach.

2.3 Approach to the sick child and clinical examination

All children must be examined fully and systematically so that no important sign will be missed. Leave the child in the arms of the mother or care taker. Do not upset the child unnecessarily. Observe as many signs as possible before touching the child; these include:

- Is the child alert, interested and looking about?
- Is the child irritable
- Does the child appear drowsy?
- Is the child convulsing?
- Is the child vomiting?
- Is the child able to suck or breastfeed?
- Is the child cyanosed or pale?
- Are there signs of respiratory distress?
- Does the child appear to breath fast?
- Is there lower chest wall in-drawing?
- Does the child use auxiliary muscles?

- Count the respiratory rate*

Examination recommended checking last:

- Checking for pallor in the palm and finger nails
- Capillary filling in finger nails or sole of foot
- Skin turgor
- Throat examination
- Otoscope examination of the ear
- Auscultation of chest and heart
- Blood pressure measurements

**Ask the mother or caretaker to cautiously reveal part of the chest to look for lower chest wall in-drawing to count the respiratory rate and at the same time observe if there is use of auxiliary muscles. If a child is disturbed or crying, it might need to be left for a brief time with its mother in order to settle, or the mother could be asked to breastfeed, before key signs such as respiratory rate can be measured.*

2.4 Laboratory investigations

Laboratory investigations have to be targeted based on the history and physical findings and aimed to narrow the differential diagnosis. The following basic laboratory investigations should be available in all small hospitals which provide pediatric care in Ethiopia:

- CBC (Hct, WBC with differential, platelets and RBC indices)
- Blood smear for malaria parasites
- Blood glucose
- Urine analysis including microscopy
- Stool microscopy
- CSF analysis and microscopy
- Blood grouping and cross-matching
- HIV counseling and testing.

In the care of sick newborns (under 1 week old), blood bilirubin (total and direct) is also an essential investigation.

Other investigations, such as pulse oximetry, chest X-ray, culture and sensitivity tests (blood, urine, stool, CSF) can help in complicated cases.

Indications for these tests are outlined in the appropriate sections of this pocket book.

2.5 Differential diagnoses

After the assessment has been completed, consider the various conditions that could cause the child's illness and make a list of possible differential diagnoses. This helps to ensure that wrong assumptions are not made, a wrong diagnosis is not chosen, and rare problems are not missed. Remember that a sick child might have more than one diagnosis or clinical problem requiring treatment.

After the main diagnosis and any secondary diagnoses or problems have been determined, treatment should be planned and started. Once again, if there is more than one diagnosis or problem, the treatment recommendations for all of them may have to be taken together. It is necessary to review the list of differential diagnoses again at a later stage after observing the response to treatment, or in the light of new clinical findings. The diagnosis might be revised at this stage, or additional diagnoses included in the considerations.

CHAPTER 3 - PROBLEMS OF THE NEWBORN AND THE YOUNG INFANT

This chapter provides guidance for the management of problems in newborns and young infants from birth to 2 months of age. This includes neonatal resuscitation, the recognition and management of neonatal sepsis and other bacterial infections, and the management of low and very low birth weight (VLBW) infants and other common neonatal problems. Drug tables for commonly used drugs in neonates and young infants are included at the end of this chapter, also providing dosages for low birth weight and premature babies.

3.1 Routine care of the newborn at delivery

Most of the newborns require only simple supportive care at and after delivery

Standardized procedures in Essential Newborn Care (ENC)

Step 1: Dry and stimulate

- Deliver the newborn on the abdomen of the mother
- Immediately dry the whole body including the head and limbs, if no meconium
- If there is meconium, thick mucus, or blood, suction the mouth and nose before proceeding to drying
- Stimulate by rubbing the back or tapping or flicking the soles of the feet
- Don't let the baby remain wet, as this will cool the baby and make it hypothermic

- Remove the wet towel and change with another dry and clean towel. Don't let the baby remain wet, as this will cool the baby and make it hypothermic
- Let the baby stay in skin-to-skin contact on the abdomen and the whole body of the baby (including the head) should be covered with the second clean and dry towel

Step 2: Evaluate Breathing

- Check if the baby is crying while drying it. If the baby does not cry, see if the baby is breathing properly
- If the baby is crying or breathing well, continue routine essential newborn care
- If the baby is not breathing and/or is gasping, clear the airways warm and stimulate by rubbing the back or tapping or flicking the soles of the feet. Provide routine care if the baby starts to breath spontaneously after this first maneuver.
- If the baby is still not breathing and/or is gasping after initial maneuver, cut the cord rapidly and take the baby to the newborn corner to start bag and mask ventilation within the first golden minute.
- If the baby breathes well, after the bag and mask ventilation, continue routine essential newborn care but monitor the baby after placing him with the mother.
- Do not do suction of the mouth and nose as a routine. Do it only if there is meconium, thick mucus, or blood.

Normal breathing

Normal breathing rate in a newborn baby is 30 to 60 breaths per minute. The baby should not have any chest in-drawing or grunting. Small babies (less than 2.5 kg at birth or born before 37 weeks gestation) may have some mild chest in-drawing and may periodically stop breathing for a few seconds.

Do not do suction of the mouth and nose as a routine. Do it only if there is meconium, thick mucus, or blood.

Step 3: Cord Care

Optimal cord care consists of the following:

- Clamping/tying the cord: If the baby does not need bag and mask ventilation, wait for cord pulsations to cease or approximately 1-3 minutes after birth, whichever comes first, and then place one single use clamp /cord tie 2 centimeters from the baby's abdomen and the second single use clamp/cord tie another 2 centimeters from the first single use clamp/cord tie.

- Cutting the cord soon after birth can decrease the amount of blood that is transfused to the baby from the placenta and, in preterm babies, it is likely to result in subsequent anemia and increased chances of needing a blood transfusion

- Cutting the cord: Cut the cord in between the two clamps/ties with sterile scissors or surgical blade, under a piece of gauze in order to avoid splashing of blood. At every delivery, a clean separate pair of scissors or blade should be designated for this purpose.

Counseling on cord care

- Check for bleeding/oozing and retie if necessary.
- The cord may be tied by using sterile cotton ties, elastic bands, or pre - sterilized disposable cord tie.
- Advise the mother not to cover the cord with the diaper
- Don't use bandages as it may delay healing and introduce infection
- Don't use alcohol for cleansing as it may delay healing.
- Don't apply traditional remedies to the cord as it may cause tetanus or other infections
- Apply 4% chlorhexidine gel immediately after cutting the cord and continue applying once daily for 7 days to prevent infection

Watch out for:

- Purulent discharge or bleeding from the cord stump
- Redness around the cord especially if there is swelling
- Fever or feels hot/cold or other signs of infection.

Step 4: Keep the newborn warm (prevent hypothermia)

- Keep the baby warm by placing it in skin-to-skin contact on the mother's chest.
- Cover the baby's body and head with clean cloth. If the room is cool ($<25^0$C), use heater to warm the room or use a blanket to cover the baby over the mother.

Step 5: Initiate breastfeeding in the first one hour

Check for the readiness of the baby to breast feed

- Eyes open
- The baby's head slightly back
- Tongue down and forward
- Mouth open
- Licking movements

Skin-to-skin contact and early breastfeeding are the best ways to keep an infant warm and prevent hypoglycaemia. Term and low-birth-weight neonates weighing <2000g should be put in prolonged skin-to-skin contact with the mother soon after birth after they have been dried thoroughly to establish faster stabilization and to prevent hypothermia.

- **Early breastfeeding** means breastfeeding within the first hour, with counseling for correct positioning and attachment.
- Early breastfeeding reduces the risk of postpartum hemorrhage for the mother.
- Colostrum (the “first milk”) has many benefits for the baby, especially anti-infective properties.
- Breastfeeding delays the mother's return to fertility because of lactation.

Breast feeding provides the best possible nutrition for the baby. Feed day and night, at least 8 times in 24 hours, allowing on-demand sucking by the baby.

- If the baby is small (<2,500 grams), wake the baby to feed every 2 hours
- If the baby is not feeding well, seek help
- Successful breastfeeding requires support for the mother from the family and health institutions
- There is no need for extra water for normal babies, even in hot climates
- Avoid use of bottles or pacifiers

Step 6: Administer eye drops/eye ointment

- Wash your hands with soap and water
- Clean eyes immediately after birth with swab soaked in sterile water, using separate swab for each eye.
- Clean from medial to lateral side.
- Apply tetracycline eye ointment/drops within 1 hour of birth usually after initiating breast feeding.
- Advise the mother not to put anything else in baby's eyes as it can cause infection and towatch out for discharge from the eyes, especially with redness and swelling around the eyes.

Step 7: Administer vitamin K Intramuscularly (IM) to all newborns

Vitamin K protects babies from serious bleeding that may result in death or brain damage. Every newborn should be given vitamin K

- 1 mg for babies with gestational age of 34 weeks or above
- 0.5 mg for premature babies less than 34 weeks gestation

Step 8: Place the newborn's identification bands on the wrist and ankle

- Put identification bands with the names of the mother, the father, and the date and time of birth on the hands and/or ankle.

Step 9: Weigh the newborn when it is stable and warm

- Place the naked baby on the paper/linen. If the linen is large, cover the baby with the cloth.
- Never leave the baby unattended on the scale.
- Inform the mother the weight of newborn

Step 10: Record all observations, weight and treatment provided in the registers/appropriate chart/cards

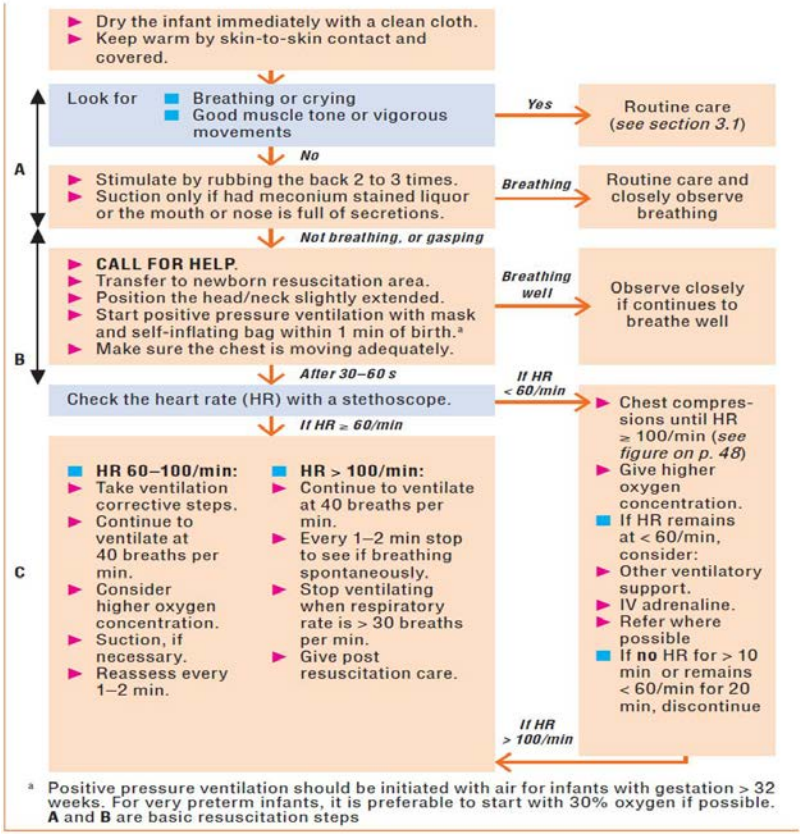
Note:

- Defer the bath for at least 24 hours.
- Clean the newborn of an HIV-infected mother as recommended
- Organize transport if necessary
- Give immunization per the national EPI schedule
- A complete examination should be performed within 90 minutes of birth or whenever the baby appears unwell.

3.2 Neonatal resuscitation

For some babies the need for resuscitation may be anticipated: those born to mothers with chronic illness, where the mother had a previous fetal or neonatal death, a mother with pre-eclampsia, in multiple pregnancies, in preterm delivery, in abnormal presentation of the fetus, with a prolapsed cord, or where there is prolonged labor or rupture of membranes, or meconium-stained liquor. However, for many babies the need for resuscitation cannot be anticipated before delivery.

Chart 3.1.A: Neonatal resuscitation


Dry the infant immediately with a clean cloth.
Keep warm by skin-to-skin contact and covered.
A
Look for
Breathing or crying
Good muscle tone or vigorous movements
Yes
Routine care (see section 3.1)
No
Stimulate by rubbing the back 2 to 3 times.
Suction only if had meconium stained liquor or the mouth or nose is full of secretions.
Breathing
Routine care and closely observe breathing
Not breathing, or gasping
B
CALL FOR HELP.
Transfer to newborn resuscitation area.
Position the head/neck slightly extended.
Start positive pressure ventilation with mask and self-inflating bag within 1 min of birth.a
Make sure the chest is moving adequately.
Breathing well
Observe closely if continues to breathe well
After 30–60 s
Check the heart rate (HR) with the a stethoscope.
If HR < 60/min
Chest compressions until HR ≥ 100/min (see figure on p. 48)
Give higher oxygen concentration.
If HR remains at < 60/min, consider:
Other ventilatory support.
IV adrenaline.
Refer where possible
If no HR for > 10 min or remains < 60/min for 20 min, discontinue
If HR ≥ 60/min
C
HR 60–100/min:
Take ventilation corrective steps.
Continue to ventilate at 40 breaths per min.
Consider higher oxygen concentration.
Suction, if necessary.
Reassess every 1–2 min.
HR > 100/min:
Continue to ventilate at 40 breaths per min.
Every 1–2 min stop to see if breathing spontaneously.
Stop ventilating when respiratory rate is > 30 breaths per min.
Give post resuscitation care.
If HR > 100/min
a Positive pressure ventilation should be initiated with air for infants with gestation > 32 weeks. For very preterm infants, it is preferable to start with 30% oxygen if possible.
A and B are basic resuscitation steps

Therefore, be prepared for resuscitation at every delivery.

Follow the assessment steps of chart 3.1A (Essential Newborn Care)

Chart 3.1.B: Neonatal resuscitation Steps and process

There is no need to slap the baby, drying is enough for stimulation.

A. Airway

- Suction airway—if there is meconium stained fluid AND baby is NOT crying and moving limbs:
  - Suck the mouth, nose and oropharynx, do not suck right down the throat as this can cause apneoa/bradycardia.

B. Breathing

- Choosing mask size: Size 1 for normal weight baby, size 0 for small (less than 2.5 kg) baby
- Ventilation with bag and mask at 40–60 breaths/minute
- Make sure the chest moves up with each press on the bag and in a very small baby make sure the chest does not move too much.

C. Circulation

- 90 compressions coordinated with 30 breaths/min (3 compressions: 1 breath every 2 seconds).
- Place thumbs just below the line connecting the nipples on the sternum (see below).
- Compress 1/3 the A-P diameter of the chest.



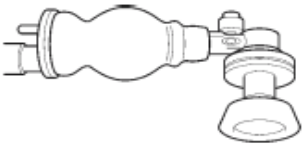
Correct head position to open up airways and for bag ventilation.
Do not hyperextend the neck



Correct position of hands for cardiac massage in a neonate. The thumbs are used for compression over the sternum

Chart 3.1.C: Neonatal resuscitation

Neonatal self-inflating resuscitation bag with round mask



Fitting mask over face:

right size and position of mask	*mask held too low*	*mask too small*	*mask too large*
			
right	*wrong*	*wrong*	*wrong*

Ventilating a neonate with bag and mask

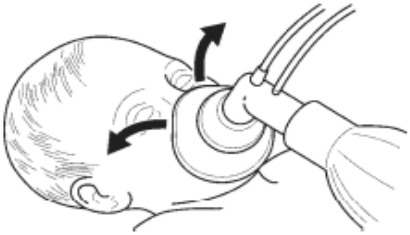
Pull the jaw forward towards the mask with the third finger of the hand holding the mask

Do not hyperextend the neck



Inadequate seal

If you hear air escaping from the mask, form a better seal. The most common leak is between the nose and the cheeks.



Post Resuscitation Care

Infants who require resuscitation are at risk for deterioration after their vital signs have returned to normal. Once adequate ventilation and circulation has been established:

- Stop ventilation
- Return to mother for skin-to-skin contact as soon as possible
- Closely monitor breathing difficulties, signs of asphyxia and anticipate need for further care.

Cessation of resuscitation

It is appropriate to consider discontinuing after effective resuscitation efforts if:

Infant is not breathing and heartbeat is not detectable beyond 10 min, stop resuscitation.

If no spontaneous breathing and heart rate remains below 60/min after 20 min of effective resuscitation, and where advanced care is not available, discontinue active resuscitation

Record the event and explain to the mother or parents that the infant has died. Give them the infant to hold if they wish so.

3.3 Prevention of neonatal infections

Many early neonatal infections can be prevented by:

- Avoid unnecessary separation of the newborn from the mother, e.g. baby unit
- Hand-washing before delivering and handling the infant
- Good basic hygiene and cleanliness during delivery Appropriate umbilical cord care

Give prophylactic antibiotics only to neonates with documented risk factors for infection:

- Membranes ruptured > 18 hr before delivery
- Mother had fever > 38°C before delivery or during labor
- Amniotic fluid was foul smelling or purulent.
- Give IM or IV ampicillin and gentamicin for at least 2 days and reassess; continue treatment only if there were signs of sepsis (or a positive blood culture).

Many late neonatal infections are acquired in hospitals. These can be prevented by:

- Exclusive breastfeeding
- Strict procedures for hand-washing or alcohol hand rubs for all staff and for families before and after handling infants
- Using Kangaroo mother care and avoiding routine use of incubators for preterm infants. If an incubator is used, do not use water for humidification (where Pseudomonas will easily colonize) and ensure that it was thoroughly cleaned with an antiseptic.
- Strict sterility for all procedures
- Clean injection practices
- Removing intravenous drips when they are no longer necessary

3.4 Management of infants with hypoxic ischaemic encephalopathy

Hypoxic ischaemic encephalopathy can result from lack of oxygen to vital organs before, during or immediately after birth. The initial treatment is effective resuscitation as above.

Problems during the days after birth:

- ***Convulsions:*** Treat with Phenobarbital; ensure hypoglycaemia is not present (check blood glucose).
- ***Apnoea:*** common after severe birth asphyxia; sometimes associated with convulsions. Resuscitate with bag and mask, and manage with oxygen by nasal prongs.
- ***Inability to suck****:* Feed with expressed breast milk via a nasogastric tube or cup. Avoid delayed emptying of the stomach, which may lead to regurgitation of feeds.
- ***Poor motor tone:*** Floppy or with limb stiffening (spasticity): physiotherapy

Prognosis can be predicted by recovery of motor function and sucking ability. An infant who is normally active will usually do well. An infant who, within a week of birth, is still floppy or spastic, unresponsive and cannot suck has a severe brain injury and will do poorly. The prognosis is less grim for infants who have recovered some motor function and are beginning to suck. The situation should be sensitively discussed with parents throughout the time the infant is in hospital.

3.5 Danger signs in newborns and young infants

Neonates and young infants often present with non-specific symptoms and signs that indicate severe illness. These signs might be present at or after delivery or in a newborn presenting to hospital or develop during hospital stay. The aim of initial management of a neonate presenting with these signs is stabilization and preventing deterioration. The signs include:

- not feeding well
- convulsions
- drowsy or unconscious

- movement only when stimulated or no movement at all
- fast breathing (>60 breaths per min)
- grunting
- severe chest indrawing
- raised temperature, > 38 °C
- hypothermia, < 35.5 °C
- central cyanosis
- severe jaundice
- severe abdominal distension

Emergency management of danger signs

- Open and maintain airway. Give oxygen by nasal prongs if the young infant is cyanosed or in severe respiratory distress or hypoxaemic (oxygen saturation ≤ 90%).
- Give bag and mask ventilation with oxygen (or room air if oxygen is not available) if there is apnoea, gasping or respiratory rate too slow (< 20).
- Insert venous cannula.

Give ampicillin (or penicillin) and gentamicin (see below)

If drowsy, unconscious or convulsing, check blood glucose. If glucose < 2.2 mmol/l (< 40 mg/100 ml), give 10% glucose at 2 ml/kg IV push. Then give a sustained IV infusion of 5 ml/kg per hour of 10% glucose while oral feeds are built up and glucose level normalizes.

If you cannot check blood glucose quickly, assume hypoglycaemia and give glucose IV. If you cannot insert an IV drip, give expressed breast milk or 10% glucose 2 ml/kg push and then 5 ml/kg per hour through a nasogastric tube.

- Give phenobarbital if convulsing.
- Admit.
- Give vitamin K (if not given before).
- Monitor the infant frequently (see below).

3.6 Convulsions

The commonest causes of neonatal convulsions include:

- hypoxic ischaemic encephalopathy (as a result of perinatal asphyxia)
- central nervous system infection
- hypoglycaemia
- hypocalcaemia

Treatment

Management of the neonate or young infant who is having a fit:

- Manage the airway and breathing.
- Ensure circulatory access.
- If hypoglycaemic, give glucose IV or via NG tube (2 ml/kg of 10% glucose). If blood glucose cannot be measured, give empirical treatment with glucose.

Treat convulsions with phenobarbital (loading dose 20 mg/kg IV). If convulsions persist, give further doses of phenobarbital 10 mg/kg up to a maximum of 40 mg/kg. Watch for apnoea. Always have a bag-mask available. If needed, continue phenobarbital at a maintenance dose of 5 mg/kg per day. If hypocalcaemic, symptoms may settle if the infant is given 2 ml/kg of 10% calcium gluconate? Preparation and dosage/monitoring as a slow IV infusion, and continue with oral supplementation.

- Rule out central nervous system infection. Treat if present (see below).

3.7 Serious bacterial infection

Newborns with documented risk factors are more likely to develop serious bacterial infection. All of the **danger signs** listed in section 3.5 are signs of serious bacterial infection, but there are others.

Localizing signs of infection are:

- signs of pneumonia
- many or severe skin pustules
- umbilical redness extending to the peri-umbilical skin
- umbilicus draining pus
- bulging fontanelle (see below)
- painful joints, joint swelling, reduced movement and irritability if these parts are handled

Treatment

Antibiotic therapy

- Empirical antibiotics should be given to a newborn with suspected neonatal sepsis.
- Admit to hospital.
- When possible, do a lumbar puncture and obtain blood cultures before starting antibiotics.

For newborns with any signs of serious bacterial infection or sepsis, give ampicillin (or penicillin) and gentamicin as first-line antibiotic treatment (for dosages, see Table 3:14 below)

- If at greater risk of staphylococcus infection (extensive skin pustules, abscess or omphalitis in addition to signs of sepsis), give IV cloxacillin and gentamicin.
- The most serious bacterial infections in newborns should be treated with antibiotics for at least 7–10 days.
- If an infant is not improving within 2–3 days, change the antibiotic treatment or refer the infant for further management

Other treatment

- If the infant is drowsy or unconscious, ensure that hypoglycaemia is not present if it is, give 2 ml/kg 10% glucose IV.
- Treat convulsions with phenobarbital
- For management of pus draining from eyes,
- If the child is from a malarious area and has fever, take a blood fi lm to check for malaria. Neonatal malaria is very rare. If confirmed, treat with artesunate or quinine
- For supportive care

3.8 Neonatal Meningitis

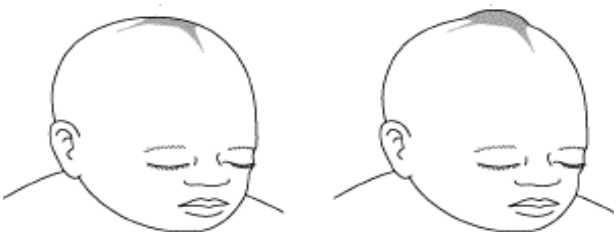
Clinical signs

Suspect meningitis if signs of serious bacterial infection are present, particularly if any one of the following is present:

The infant is:

- Drowsy, lethargic or unconscious
- Convulsing
- Has a bulging fontanelle
- Irritable
- Has a high-pitched cry.

It is important to attempt lumbar puncture once the infant has been stabilized, ideally within 2 hours of initiating antibiotic treatment, because it serves to confirm the diagnosis.



Normal fontanelle Bulging fontanelle

Figure 3.1: Bulging fontanelle – sign of meningitis in young infants with an open fontanelle

Treatment

- The first-line antibiotics are ampicillin and gentamicin for 3 weeks
- Alternatively, give a third-generation cephalosporin, such as ceftriaxone (50 mg/kg every 12 hr) or cefotaxime (50 mg/kg every 12 hour if < 7 days or every 6–8 hourr if > 7 days of age), and gentamicin for 3 weeks.
- If there are signs of hypoxaemia, give oxygen
- If the infant is drowsy or unconscious, ensure that hypoglycaemia is not present if it is, give 2ml/kg 10% glucose IV.Treat convulsions (after ensuring they are not due to hypoglycaemia or hypoxaemia) with phenobarbital Make regular checks for hypoglycaemia.

3.9 Supportive care for sick neonates

Neonatal Thermoregulation

Hypothermia

The normal body temperature is between 36.5^0C -37.5^0C.

Hypothermia is defined as skin (axillary) temperature less than 36.5^0C.

Newborns are at risk of hypothermia because of their large surface area for small body mass.

Prevention

Before delivery:

- Warm the delivery room
- Organize newborn corner with adequate heat source

At delivery:

- Dry the baby thoroughly immediately after birth and remove wet clothes.
- Use cap to prevent significant heat loss through the scalp
- Keep the newborn in skin to skin contact with the mother
- Keep the newborn under pre-heated radiant warmer–if resuscitation is needed
- Cover weighing scales with warm towel
- Initiate early breast feeding

Subsequent care

- Arrange appropriate transportation if needed
- Postpone bathing (bath after 24 hours)
- Warm hands and stethoscope before touching the baby
- Do examination/resuscitation of the infant under the radiant warmer
- Practice rooming in wards/post natal rooms
- Keep the newborn away from windows and drafts
- Continue breast feeding

General management

- Identify and treat cause of hypothermia (disease process and environmental conditions)
- Put hypothermic infants on KMC, in incubators or under radiant warmer.
- Warm the new born slowly (see management of severe hypothermia)
- Monitor axillary temperature every 30 minutes till newborn temperature becomes stable

Monitor environmental temperature

Management of newborns with severe hypothermia

- Warm the baby using a pre-warmed radiant warmer.
- Remove cold or wet cloths.
- Cover the baby with warm clothes and hat.
- Treat for sepsis ,if present
- Measure blood glucose and treat if hypoglycemic.
- Keep IV line under the radiant warmer to warm the fluid.
- Measure the baby's temperature every hour.
- If the baby's temperature is increasing at least 0.5 °C per hour in the 1st three hours, re-warming is successful.
- Then measure the baby's temperature every two hours.

If the baby's temperature does not rise or is rising more slowly than 0.5°C per hour, check and reset temperature of the warmer.

Once the baby's temperature is normal, measure the temperature every three hours for 12 hours and then 12 hourly.

- Monitor for complications and manage accordingly

- Look for respiratory problems
- Monitor vital signs
- Monitor urine output
- Monitor blood sugars
- Look for signs multi organ failure

- Dangers of warmers
- Hyperthermia
- Dehydration
- Mask serious infections

Fever: is considered when axillary temperature is above 37.5^{o}C.

The most common cause of high temperature (fever) in newborns and young infants is environmental temperature; however infection has to be ruled out. Do not use antipyretic agents such as paracetamol for controlling fever in young infants. Control the environment. If necessary, undress the child and investigate for possible bacterial infection.

Signs of high temprature

- The newborn will be tachypnic
- Excessive sweating
- Flushed, bright and pink skin

Management

- Initiate early and frequent breast feeding
- Keep the baby away from source of excessive heat
- Remove extra cloths
- Look for possible causes including infections and treat accordingly.

Fluid management

- Encourage the mother to breastfeed frequently to prevent hypoglycaemia. If the infant is unable to feed, give expressed breast milk by nasogastric tube or cup.
- Withhold oral feeding if there is bowel obstruction, necrotizing enterocolitis, or the feeds are not tolerated, indicated e.g. by increasing abdominal distension or vomiting everything.
- Withhold oral feeding in the acute phase in infants who are lethargic, unconscious or having frequent convulsions.

If IV fluids are given, reduce the rate as the volume of oral or gastric milk feeds increases. IV fluids should ideally be given with an in-line burette to ensure the exact doses of fluids prescribed.

Increase the amount of fluid given over the first 3–5 days (total amount, oral plus IV).

- Day one 60 ml/kg per day
- Day two 90 ml/kg per day
- Day three 120 ml/kg per day

Then increase to 150 ml/kg per day

When the infant tolerates oral feeds well, the amount of fluid might be increased to 180 ml/kg per day after some days. Be careful in giving parenteral IV fluids, which can quickly overhydrate a child. Do not exceed 100 ml/kg per day of IV fluids, unless the infant is dehydrated or under phototherapy or a radiant heater. (You can add 10% extra fluid during such circumstances)

This amount is the total fluid intake an infant needs, and oral intake must be taken into account when calculating IV rates.

- Give more fluid if the infant is under a radiant heater (1.2–1.5 times).
- During the first 2 days of life give 10% glucose infusion IV. Do not use IV glucose without sodium after the first 2 days of life. Suitable alternative IV fl uids after the fi rst 2 days are half normal saline and 5% dextrose.

Monitor the IV infusion very carefully (ideally through an in-line burette).

- Use a monitoring sheet.
- Calculate the drip rate.
- Check the drip rate and volume infused every hour.
- Weigh the infant daily.
- Watch for facial swelling: if this occurs, reduce the IV fl uid to a minimum or take out the IV line. Introduce breastfeeding or milk feeding by orogastric or nasogastric tube as soon as it is safe to do so

Oxygen therapy

Give oxygen to neonates or young infants with any of the following:

- central cyanosis or gasping
- grunting with every breath
- difficulty in feeding due to respiratory distress
- severe lower chest wall indrawing, head nodding (i.e. a nodding movement of the head, synchronous with the respiration indicating severe respiratory distress)

Use a pulse oximeter to guide oxygen therapy. Oxygen should be given if the oxygen saturation is ≤ 90%, and the oxygen flow should be regulated to maintain saturation of > 90%. Oxygen can be discontinued once the infant

can maintain saturation> 90% in room air. Nasal prongs are the preferred method for delivering oxygen to this age group, with a flow rate of 0.5–1 litre/min, increased to 2 litres/min in severe respiratory distress to achieve oxygen saturation > 90%.

Thick secretions should be cleared from the throat by intermittent suction under direct observation, if they are obstructing the airway and the infant is too weak to clear them. Oxygen should be stopped when the infant's general condition improves and the above signs are no longer present.

3.10 Preterm and low-birth-weight infants

3.10.1 Infants with a birth weight of 2.0–2.5 kg (35–36 weeks' gestation)

These infants are usually strong enough to breastfeed and maintain their body temperature. Start feeds within 1 hour of delivery. Their mothers usually need additional support for exclusive breastfeeding. They should be kept warm at all times. All low-birth-weight infants are at risk of infection and should be closely observed for infection control.

3.10.2 Infants with a birth weight < 2.0 kg (< 35 weeks' gestation)

All infants with a gestation < 35 weeks or a birth weight < 2.0 kg should be admitted to a special care unit. These infants are at risk of hypothermia, feeding problems, apnoea, respiratory distress syndrome and necrotizing enterocolitis. The smaller the infant, the higher the risk. The risks associated with keeping the child in hospital (e.g. hospital-acquired infections) should be balanced against the potential benefit of better care.

See the infants at least twice a day to assess feeding ability, fluid intake or the presence of any danger signs or signs of serious bacterial infection. If any of these signs is present, it should be closely monitored. Management of common problems is discussed below.

Feeding

Many low-birth-weight infants will be able to suckle at the breast. Infants who can suckle should be breastfed. Those who cannot breastfeed should be given expressed breast milk with a cup and spoon. When the infant is

sucking well at the breast and gaining weight, reduce the cup feeds. Infants unable to feed from a cup and spoon should be given intermittent bolus feeds through a gastric tube.

Feed the infant only the mother's own milk. In exceptional situations, when this is not possible, donated human milk should be given, if safe milk-banking facilities are available. Formula should be given only if neither of the above is possible.

Special feeding considerations for infants weighing < 1.5 kg at birth

These infants are at the highest risk of feeding problems and necrotizing enterocolitis. The smaller the infant, the higher the risk.

Starting on the first day, give 10 ml/kg per day of enteral feeds, preferably expressed breast milk, with the remaining fluid requirement at 50 ml/kg per day met by IV fluids. If the infant is well and active and not receiving IV fluids, give 2–4 ml of expressed breast milk every 2 hr through a nasogastric tube, depending on the weight of the infant.

If the infant cannot tolerate enteral feeds, give IV fluids at 60 ml/kg per day for the first day of life. It is best to use a paediatric (100 ml) intravenous burette; 60 drops=1 ml, therefore one drop per minute = 1 ml/hr.

Check blood sugar every 6 hr until enteral feeds are established, especially if the infant is apnoeic, lethargic or convulsing. Very low-birth-weight infants may need a 10% glucose solution.

Start enteral feeding when the condition of the infant is stable and there is no abdominal distension or tenderness, bowel sounds are present, meconium passed and no apnoea.

- Calculate exact amounts for feeding and the timing of feeds.
- Use a prescription chart.
- Increase daily if well tolerated.

When commencing milk feeds, start with 2–4 ml every 1–2 hours by orogastric or nasogastric tube. Some active very-low-birth-weight infants can be fed with a cup and spoon or an eyedropper, which must be sterilized before each feed. Use only expressed breast milk if possible. If a 2–4-ml volume is tolerated with no vomiting, abdominal distension or gastric aspirates of more than half the feed, the volume can be increased by 1–2 ml per feed each day. Reduce or withhold feeds if there are signs of poor tolerance.

Aim to establish feeding within the fi rst 5–7 days so that the IV drip can be removed, to avoid infection.

The feeds may be increased during the fi rst 2 weeks of life to 150–180 ml/kg per day (3-hourly feeds of 19–23 ml for a 1-kg infant and 28–34 ml for a 1.5-kg infant). As the infant grows, recalculate the feed volume on the basis of the higher weight.

Give daily supplements when the infant is accepting full enteral feeds:

- Vitamin D at 400 IU
- Calcium at 120–140 mg/kg
- Phosphorus at 60–90 mg/kg.
- Start iron supplements at 2 weeks of age at a dosage of 2–4 mg/kg per day Until 6 months of age.

Preventing hypothermia

Low-birth-weight neonates (weighing <2000 g) should be given Kangaroo mother care starting soon after birth and ensured at all times, day and night. (See section on Kangaroo mother care)

If the mother is unable to provide Kangaroo mother care, a clean incubator can be used. Incubators should be washed with disinfectant between

infants and should be of a basic design that can be used appropriately by the staff available.

3.11 Kangaroo Mother Care (KMC)

"Let nature do the nurturing". The common problems of small babies–hypothermia, hypoglycaemia, and hypoxia-are alleviated, if



Figure 3.2: KMC

not cured, by a common solution: kangaroo mother care (KMC). ALL facilities with maternity services SHOULD implement KMC as routine practice.

What is KMC?

Kangaroo mother care consists of skin-to-skin care of babies (usually low birth weight or very low birth weight). KMC also promotes early and exclusive breastfeeding, but may be used even when babies are formula fed.

What are the cornerstones of KMC?

Kangaroo Position

Dress the baby in a nappy and cap and place in an upright position against the mother's bare chest, between her breasts and inside her blouse. One may use a special garment, or one can tuck the mother's blouse under the

baby or into her waistband. Cover both mother and baby with a Gabi, blanket or jacket if it is cold. You too can be innovative.

Steps in positioning the baby for KMC:

1. Dress the baby in socks, a nappy, and a cap.
2. Place the baby between the mother's breasts.
3. Secure the baby on to the mother's chest with a cloth
4. Put a blanket or a shawl on top for additional warmth.
5. Instruct the mother to put on a front-opened top: a top that opens at the front to allow the face, chest, abdomen, arms and legs of the baby to remain in continuous skin-to-skin contact with the mother's chest and abdomen.

- Instruct the mother to keep the baby upright when walking or sitting.
- Advise the mother to have the baby in continuous skin-to-skin contact 24 hours a day (or less in the case of intermittent KMC).
- Advise the mother to sleep in a half sitting position in order to maintain the baby in a vertical position.

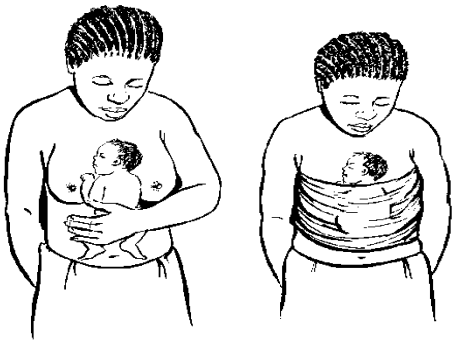


Figure 3.3: KMC Position

Securely wrap the baby with a cloth tied around the mother. (Illustration adapted from Home Based Life Saving Skills - Baby Information. Buffington, Sibley, Beck and Armbruster, 2004. American College of Nurse-Midwives, ISBN 0-914324-09-8.)

Kangaroo Nutrition

Babies who are unable to suckle should be fed expressed breast milk via a nasogastric tube or cup if they can swallow. Keep babies in the KMC position whilst being tube fed. Allow them to try to suckle during the tube feed.

In the KMC position, babies will declare themselves ready to suckle, as their rooting and suckling reflexes become manifest. Once the baby is able to suckle, allow the baby to breast feed on demand but at least every 2-3 hours.

Kangaroo Support

It is very important to explain and demonstrate to the mother until she is motivated and confident to try the kangaroo position. Assist the mother with positioning and feeding, and give emotional support. The concept should be explained to other family members (especially the maternal grandmother), and they can also practice KMC (especially the father).

When do we start KMC?

Intermittent KMC can be practiced while the baby is still in NICU. It is possible even with babies on oxygen and IV therapy. Frequency is determined by how stable baby is. A common sense approach is best.

- Continuous KMC can be instituted once the baby is stable, suckling well and needs no additional care. The baby can then be transferred to

an adjoining KMC ward. Smaller babies may be able to go onto continuous KMC if they are stable and do not require oxygen.

What is the daily routine of a KMC Ward?

Monitoring

Babies should be weighed daily, and feeds adjusted according to weight gain. If not yet breastfeeding on demand, they should receive 175ml/kg/day, in 8 feeds 3 hourly.

Babies on oxygen should have their oxygen saturation monitored 3 hourly. The Basic Neonatal Nursing Observation chart can be used.

When to discharge from the hospital

Discharge:

- when the baby has a sustained weight gain of at least 15 grams /kg /day for three consecutive days
- when the baby can maintain temperature in a normal range for three days
- when the baby is able to suck breast adequately
- if the mother is confident and able to give KMC at home

Bring the baby back for follow up in the next few days to ensure that baby is well and growing. It is advised practice to follow up KMC babies in a designated place.

Where do we do continuous KMC?

The KMC ward should be in close proximity to the Neonatal Unit and under the supervision of the neonatal staff, with 24 hour nursing coverage. The ward should be comfortable, homely and warm but not heated. There should be no cribs.

Discharge from KMC position

Discharge from the kangaroo positions is usually determined by the babies themselves. When babies are about 40 weeks post menstrual or when their weight is about 2500 grams (whichever comes first), babies will not be comfortable in kangaroo position and move a lot to indicate that they no more need the position. Then the health worker or the mother needs to discharge the baby from the kangaroo position.

3.12 Common problems of low-birth-weight infants

Respiratory distress syndrome

Preterm infants are at risk for respiratory distress syndrome due to surfactant deficiency. This can be reduced if pregnant mothers at risk for premature delivery (e. g. premature contractions or premature rupture of membranes) are given dexamethasone at two doses of 12 mg 24 h apart. Respiratory distress usually occurs in a preterm infant during the fi rst 3 days of life. It is a self-limiting condition, because birth triggers an increase in surfactant production.

The challenge is to support the infant for the fi rst few days of life until such time as the deficiency resolves.

The key clinical features usually become obvious within 4 h of birth and include:

- tachypnoea
- an expiratory 'grunt'
- intercostal and/or subcostal recession and cyanosis.

Treatment

The principles of treatment are:

- minimal handling of the infant

- supplementary oxygen if needed to keep the oxygen saturation > 90% but < 95% to avoid eye damage
- initially no oral feeding
- IV fl uids (see above)
- maintenance of a normal temperature range
- IV antibiotics for neonatal sepsis, as it is diffi cult to exclude pneumonia as a cause of respiratory distress

Continuous positive airway pressure (**CPAP**) is used, even in expiration, to prevent airway collapse, improve oxygenation and reduce breathing fatigue.

If there is persistent respiratory distress or hypoxaemia, do chest X-ray to check for pneumothorax.

Apnea

It is a disorder of respiratory control characterized by absence of air flow for ≥20 seconds or less than that if it is accompanied by bradycardia (heart rate <100/min) or cyanosis. It is classified in to three types:

1. Central – no airflow, no respiratory efforts
2. Obstructive – no airflow, despite respiratory efforts
3. Mixed – often begins as central and later becomes obstructive

It commonly occurs in premature newborns due to immaturity of brain functions and generally begins 1 or 2 days after birth. In term newborns, it occurs in association with serious identifiable causes.

Etiology

- Prematurity, infection, metabolic abnormalities
- Hypoxemia, anemia, hypo or hyperthermia
- Gastroesophageal reflux
- Upper airway malformations (TEF)

Preventing apnoea

- Maintain normal hematocrit, electrolytes and PaO2
- Avoid neck flexion and abdominal distension
- Kangaroo Mother Care (KMC)

Management

Methylxanthines

Aminophylline

- Loading dose 8mg/kg IV infusion over 30 minutes
- Maintenance – 1.5 to 3mg/kg IV every 8 to 12 hours.

Caffeine – loading dose 20 to 25mg/kg IV slow push every 24 hours

CPAP

Kangaroo mother care

Maintain normal hematocrit, electrolytes and PaO_2

Avoid neck flexion and abdominal distension

Treat underlying etiology

Necrotizing enterocolitis (NEC)

Necrotizing enterocolitis (a bowel infection) may occur in low-birth-weight infants, especially after enteral feeds are started. The condition is commoner in low-birth-weight infants fed artificial formulae but may occur in breastfed infants.

Common signs of necrotizing enterocolitis are:

- abdominal distension or tenderness
- intolerance to feeding
- bile-stained vomit or bile-stained fl uid up the nasogastric tube
- blood in the stools
- *Other signs of systemic illness may present including*

- apnoea
- drowsiness or unconsciousness
- fever or hypothermia

Treatment

- Stop enteral feeding.
- Pass a nasogastric tube and leave it on free drainage.
- Start an IV infusion of glucose–saline.
- Start antibiotics: give ampicillin (or penicillin) plus gentamicin plus metronidazole for 10 days.
- If the infant has apnoea or other danger signs, give oxygen by nasal catheter. If apnoea continues, give aminophylline or caffeine IV.
- If the infant is pale, check the Hb, and transfuse if Hb < 10 g/dl.
- Take a supine and lateral decubitus abdominal X-ray. If there is gas in the abdominal cavity outside the bowel, there may be bowel perforation. Ask a surgeon to see the infant urgently.
- Examine the infant carefully each day. Reintroduce expressed breast milk feeds by nasogastric tube when the abdomen is soft and not tender, the infant is passing normal stools with no blood and is not having bilious vomiting. Start feeds slowly and gradually increase by 1–2 ml per feed each day.

3.13 Discharge and follow-up of low-birth-weight infants

Low-birth-weight infants can be discharged when:

- They have no danger signs or signs of serious infection
- They are gaining weight on breastfeeding alone

- They can maintain their temperature in the normal range (36–37 °C) in an open cot
- The mother is confident and able to care for the infant.

Low-birth-weight infants should be given all the scheduled vaccines at the time of birth and any second doses that are due by the time of discharge.

Counseling on discharge

Counsel parents before discharge on:

- Exclusive breastfeeding
- Keeping the infant warm
- Danger signs for seeking care

Low-birth-weight infants should be followed up weekly for weighing and assessment of feeding and general health, until they have reached 3 kg.

3.14 Other common neonatal problems

3.14.1 Neonatal Jaundice

Definition - is a yellowish discoloration of the skin and or sclera due to bilirubin deposition.

In newborns, jaundice appears when total bilirubin (TB) is more than 7 mg /dl and more than 50 % healthy full term babies and 80% of preterm babies have some jaundice. Neonatal jaundice can be classified as either physiologic or pathologic.

Table 3.1: Features differentiating Physiological jaundice from Pathological Jaundice

No	Features	Physiologic Jaundice	Pathological Jaundice
1	Clinical onset of jaundice (after birth)	>24 hrs	<24 hrs
2	Jaundice still clinically visible (day after birth)	Term < 8 days Preterm < 14 days	Term ≥8 days Preterm > 14 days
3	Peak Total Serum Bilirubin (TSB)	Term < 12 mg/dl Preterm < 15 mg/dl	Term > 12 mg/dl Preterm > 15 mg/dl
4	Rise in TSB	< 5mg/dl/24 hrs	> 5mg/dl/24 hrs
5	Conjugated serum bilirubin level	<2mg/dl	>2mg/dl or 15 % of TB

Causes of Jaundice

- Isoimmunization: RH incompatibility, ABO incompatibility, Other blood group incompatibility
- Infection: Bacterial, viral, protozoal
- Breast milk induced jaundice
- Breastfeeding jaundice
- Sequestered blood: Subgaleal hemorrhage, cephalhematoma, ecchymosis, hemangioma

Erythrocyte biochemical defect: G6PD deficiency, Hexokinase deficiency

Structural abnormalities of erythrocytes: Hereditary spherocytosis, elliptocytosis

- Disorder of hepatic uptake: Gilbert syndrome
- Disorder of conjugation: Crigler-Najjar syndrome (absence of UGT activity)

- Hypothyroidism: Disorder of enterohepatic circulation (associated with breast feeding practice)
- Idiopathic jaundice

Clinical manifestations

- A newborn presents with yellowish discoloration of sclera, skin, mucus membranes
- Depending on severity and time of presentation a newborn may present with signs of bilirubin encephalopathy.

The following risk factors aggravate bilirubin encephalopathy:

- Prematurity
- Metabolic acidosis,
- Hypoglycemia,
- Sepsis,
- Temperature instability,
- Significant lethargy
- Low serum albumin

Complications of hyperbilirubinemia

Acute bilirubin encephalopathy is early bilirubin toxicity, which is transient and reversible. If it is not recognized or untreated, it may progress to permanent neurologic impairment-Kernicterus.

Acute bilirubin encephalopathy has three phases

- **Phase 1 (first 2 days of age):** Poor motor reflex, high pitched cry, decreased tone, lethargy, poor feeding
- **Phase 2 (middle of 1st week of age):** Hypertonia, seizure and depressed sensorium, fever, opisthotonos posturing, paralysis of upward gazing.

- **Phase 3 (after 1week of age):**Hypertonia decreases, Hearing and visual abnormality, poor feeding, Athetosis and seizure may also occur
- ***Chronic bilirubin encephalopathy (Kernicterus) seen after 1 year of age and manifests with***
    - Choreoathetoid cerebral palsy
    - Upward gaze palsy
    - Sensorineural hearing loss
    - The intellect may be spared with severe physical handicap

Investigations

- Total bilirubin
- Direct and indirect bilirubin
- Maternal blood group and RH type
- Neonatal blood group and RH type
- Direct/indirect Coombs test
- Hemoglobin (Hgb) or hematocrit (HCT)
- Peripheral RBC morphology
- Reticulocyte production index(RPI)
- Serum albumin level and albumin to bilirubin ratio
- Liver function test (LFT)
- Septic work up.
- Abdominal ultrasound with indication.

Management of Unconjugated Hyperbilirubinemia

The main goal of treatment is to avoid acute and chronic bilirubin encephalopathy by reducing serum bilirubin level.

Note: Always categorize babies into low, medium or high risk based on the Bhutani curve as shown below before deciding on the management options.

Principles of treatment include:

1. *Phototherapy*
2. *Exchange transfusion*
3. *Other medical managements*

- ***Phototherapy***– It is the mainstay of treatment
- It is indicated for excessive unconjugated hyperbilirubinemia (see Bhutani curve for phototherapy).
- It acts by photoisomerization, structural isomerization, and photooxidation.
- It is not a substitute for exchange transfusion if exchange transfusion indicated.
- Intensive phototherapy is preferred if available.
- Infant should get adequate feeding.
- Cover the baby's eye and put diaper with maximum body surface area being exposed.
- Make sure that the distance between the light source and the baby should be less than 40 cm.
- The position should be changed every 2 hours from supine to prone.
- Measure weight daily and increase fluid intake by 25 % extra over the usual requirement to compensate the insensible water loss.
- Give a bolus of fluid with Normal saline 20ml/kg if bilirubin remains high

Side effects of phototherapy

- Insensible water loss
- Watery and frequent stool
- Retinal damage
- Erythema and increased blood flow
- Bronze baby syndrome (with increased CB)
- Low calcium level (in preterm)
- Interferes with maternal infant bonding

1. Double Volume Exchange transfusion

See Bhutani curve for indications of Double volume exchange transfusion.

The amount of blood volume to be exchanged is equivalent to 2x the blood volume of the baby (85ml/kg)

  - Example for a newborn weighing 3 kilograms the amount of blood to be exchanged is calculated as follows= 2 x 85ml/kg x3kg =510 ml

- Do procedure after umbilical catheterization using aseptic technique
- Heparinize the catheter (instill heparin to the tube) before starting the procedure.
- The amount of blood to be removed at a time is 5ml to 20 ml
- Strictly monitor the vital signs during the procedure.
- Determine post transfusion hematocrit 4-6 hours after the procedure.
- Determine bilirubin 4 hourly after the procedure.
- Monitor RBS every 30-60 minutes during the procedure and 2-4 hourly for the first 24 hours after procedure.

- Administer 1ml/kg of Calcium gluconate slowly via a peripheral vein under strict cardiac monitoring after 100ml of blood is exchanged.
- If the cord is infected or there is a breach in the aseptic technique, it is wise to start on prophylactic dose of Cloxacillin 50mg/Kg bid for 2- 3 days and gentamicin 5mg/kg BID for 2-3 days.
- Keep baby NPO for 4 hours before and after procedurebecause it can predispose the baby to necrotizing enterocolitis.

Selection of blood to be transfused to the newborn

- If there is Rh hemolytic disease – give blood group compatible to the baby and RH to the mother.
- If there is ABO hemolytic disease – give blood group of the mother and Rh compatible to the newborn

Note: O negative blood is the most preferable type for exchange transfusion.

Complication of exchange transfusion

- Cardiac and respiratory disturbances (arrhythmia, volume overload, perforation of vessels)
- Shock, due to bleeding disorder (clotting factor deficiency) or inadequate replacement of blood.
- Infection (strict infection screening to reduced this risk)
- Clot formation (causing occlusion of catheters, impairment of blood flow to the organs due to thromboembolism)
- Alterations in blood chemistry (high potassium, low calcium, low glucose, decreased in pH)

- Rare but severe complications include air embolism, portal hypertension and necrotizing enterocolitis.

Other treatment modalities

- Phenobarbital 5 mg/kg to stimulate liver enzyme in Crigler-Najjar syndrome.
- High dose of IV immunoglobulin.
- In case of breast milk jaundice, discontinuation of breast milk for 1-3days usually causes a prompt decline, whereas in jaundice associated with failure of breast-feeding (breast-feeding jaundice) increase the amount of feeding.

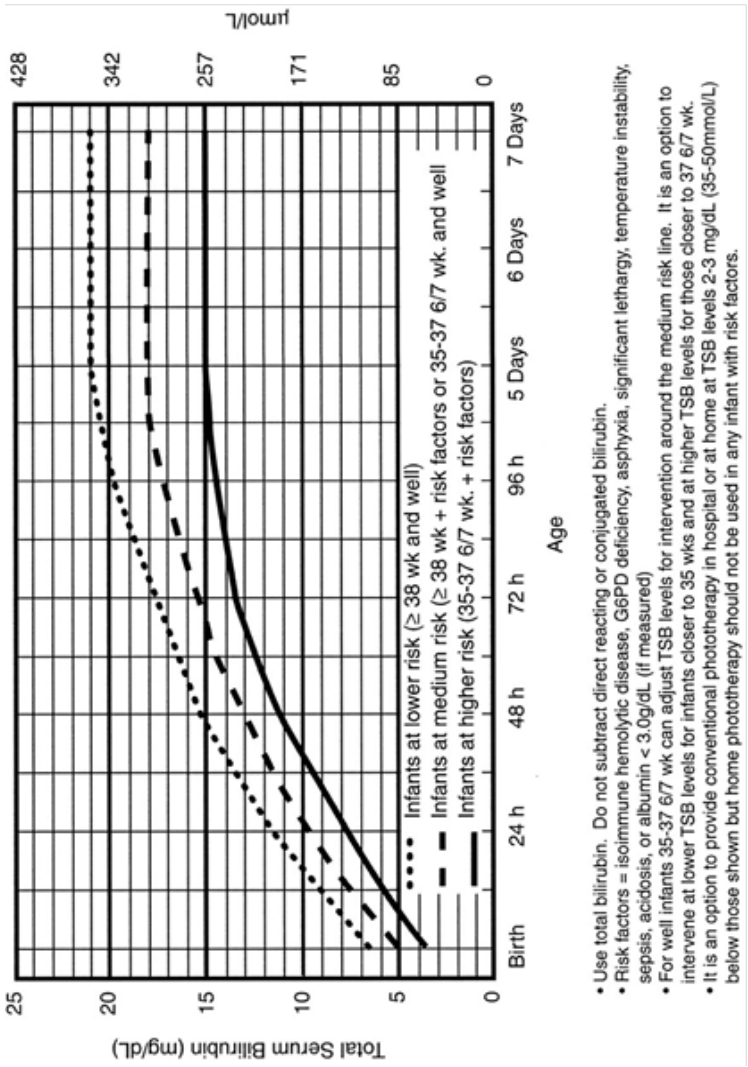

Total Serum Bilirubin (mg/dL)
25
20
15
10
5
0
µmol/L
428
342
257
171
85
0
Birth
24 h
48 h
72 h
96 h
5 Days
6 Days
7 Days
Age
Infants at lower risk (≥ 38 wk and well)
Infants at medium risk (≥ 38 wk + risk factors or 35-37 6/7 wk. and well
Infants at higher risk (35-37 6/7 wk. + risk factors)
• Use total bilirubin. Do not subtract direct reacting or conjugated bilirubin.
• Risk factors = isoimmune hemolytic disease, G6PD deficiency, asphyxia, significant lethargy, temperature instability, sepsis, acidosis, or albumin < 3.0g/dL (if measured)
• For well infants 35-37 6/7 wk can adjust TSB levels for intervention around the medium risk line. It is an option to intervene at lower TSB levels for infants closer to 35 wks and at higher TSB levels for those closer to 37 6/7 wk.
• It is an option to provide conventional phototherapy in hospital or at home at TSB levels 2-3 mg/dL (35-50mmol/L) below those shown but home phototherapy should not be used in any infant with risk factors.

Figure 3.4: Bhutani curve: phototherapy indication in hospitalized infants of 35 or more weeks' gestation

Infants at lower risk (≥ 38 wk and well)
Infants at medium risk (≥ 38 wk + risk factors or 35-37 6/7 wk. and well
Infants at higher risk (35-37 6/7 wk. + risk factors)
Total Serum Bilirubin (mg/dL)
μmol/L
30
25
20
15
10
513
428
342
257
171
Birth
24 h
48 h
72 h
96 h
5 Days
6 Days
7 Days
Age
• The dashed lines for the first 24 hours indicate uncertainty due to a wide range of clinical circumstances and a range of responses to phototherapy.
• Immediate exchange transfusion is recommended if infant shows signs of acute bilirubin encephalopathy (hypertonia, arching, retrocollis, opisthotonos, fever, high pitched cry) or if TSB is ≥5 mg/dL (85 μmol/L) above these lines.
• Risk factors - isoimmune hemolytic disease, G6PD deficiency, asphyxia, significant lethargy, temperature instability, sepsis, acidosis.
• Measure serum albumin and calculate B/A ratio (See legend)
• Use total bilirubin. Do not subtract direct reacting or conjugated bilirubin
• If infant is well and 35-37 6/7 wk (median risk) can individualize TSB levels for exchange based on actual gestational age.

Figure 3.5: Bhutani curve: Exchange transfusion in infants of 35 or more weeks' gestation

3.14.2 Neonatal Conjunctivitis

Red and swollen eyes or eyes draining pus may be caused by bacteria (e.g. gonococcus, chlamydia, and staphylococcus)

A. If there is stickiness of eyelids, swelling and/or redness but no pus discharge,

- Clean the eyelids using sterile normal saline or clean (boiled and cooled) water and a clean swab, cleaning from the inside edge of the Eye to the outside edge;
- Have the mother do this whenever possible; repeat four times daily until the eye problems have cleared.
- If the problem persists after 4 days of the above measures treat for Chlamydia:
- Give erythromycin by mouth for 14 days;
- Apply 1% tetracycline ointment to the affected eye(s) four times daily until the eye(s) is no longer red, swollen, or sticky.



B. If eyes are draining pus (Opthalmia Neonatorum)

a. If the Baby is less than 7 days, treat for gonococcal infection.

- ***If possible*** take a specimen of pus using a sterile cotton swab, and send it to the laboratory for gram stain and/or culture and sensitivity, so that treatment will be modified accordingly.
- Give Ceftriaxone 50mg/kg IM stat.
- Clean the eyelids using sterile normal saline or clean (boiled and cooled) water and a clean swab, cleaning from the inside edge of the Eye to the outside edge;
- Have the mother do this whenever possible and repeat four times daily until the eye problems have cleared.
- Treat the mother and her partner for gonorrhoea if not already treated give:
- Ceftriaxone 250 mg IM as a single dose to the mother;
- Ciprofloxacin 500 mg by mouth as a single dose to her partner.

3.14.3 Common hematologic problems of the neonate

Approach to a neonate with bleeding disorder

Introduction

- Neonates have decreased activity of clotting factors (II, VII, IX, X), impaired platelet function, and suboptimal defense against clot formation.
- HDN in well babies and disseminated intravascular coagulations (DIC) in sick babies are among the commonest problems.

Hemorrhagic disease of the newborn (HDN)

Definition: HDN occurs in the healthy infant due to Vitamin K deficiency.

Disseminated intravascular coagulation (DIC)

Definition: DIC it's a systemic process producing both thrombosis and hemorrhage due to activation and dysregulation of the hemostatic system.

DIC in newborn is due to infection, cold injury, asphyxia or tissue damage and necrosis. The baby usually appears sick and may have petechiae, gastrointestinal bleeding, oozing from vein puncture.

Table 3.2: Classification, risk factors, prevention, treatment and incidence of HDN according to time of onset

Classification	Early onset	Classic disease	Late onset
Age	0 – 24 hrs	2 – 7 days	>1wk – 12 weeks of age
Prevention	Vitamin- K 0.5 (Preterm) – 1 mg (term) IM at birth.	Vitamin- K 0.5 (Preterm) – 1 mg (term) IM at birth.	Vitamin- K 0.5 (Preterm) – 1 mg (term) IM at birth.
Treatment	Vit- K 1mg - 5mg IV Fresh frozen plasma 10 - 20 ml/kg in serious bleeding, prematurity, liver disease Treat shock by blood transfusion	Vit- K 1mg - 5mg IV Fresh frozen plasma 10 - 20 ml/kg in serious bleeding, prematurity, liver disease Treat shock by blood	Vit- K 1mg at arrival then at 1 wk, 4 wks, and 8 wks

Laboratory findings

- Decreased platelet count and increased PT and PTT
- Decreased fibrinogen
- Management
- Treat the underlying cause
- Vitamin K 1 mg IV.

Platelet and fresh-frozen plasma 10-20ml/kg may be considered for moderate-to-severe bleeding

If bleeding persists do exchange transfusion and continue to transfuse with fresh-frozen plasma and platelet.

Polycythemia

Definition: Polycythemia is defined as a peripheral venous blood of HCT > 65 %. Capillary blood sample is higher by 10 - 15 % than venous blood.

Management: Partial exchange transfusion

The procedure should be done under strict aseptic technique after umbilical catheterization

- Partial exchange transfusion in **symptomatic** patients if venous HCT is > 65%.
- Increase fluid intake and repeat HCT in 4 to 6 hrs in asymptomatic infants with venous HCT between 65% - 70%.
- Partial volume exchange transfusion when the peripheral venous HCT is >70% even in the absence of symptoms.

- Partial volume exchange transfusion is done by withdrawing blood from umbilical vein and replacing it with **Normal saline** using the formula as shown below.
- The amount of blood to be removed at a time is 5ml to 20 ml depending on the gestational age, birth weight and of the infant. The lower range is used for preterm, VLBW, and critically ill infants. The higher amount of aliquot should be utilized in stable newborns that are term with normal birth weight.
- Determine post transfusion hematocrit after 4-6 hours after the procedure
- Monitor RBS every 2-4 hours for the first 24 hours after procedure.

- Keep baby NPO for 4 hours before and after procedure for prevention of NEC and put him on maintaince fluids.

Volume of exchange in ml =

Blood volume of newborn x (observed HCT-Desired HCT*)

Observed HCT

***Desired HCT=55%**

Example: What is the amount exchanged in a newborn weighing 3kg infant and hematocrit of 75 % the amount of blood to be exchanged is calculated as follows. Volume of blood for term baby is 85ml/kg and for a preterm to bring HCT to 55 %.

Volume of exchange in ml = $\frac{85ml \times 3kg \times 75-55}{75}$

$= \frac{255X\ 22}{75}$

= 68 ml blood will be exchanged with equal amount of normal saline

Anemia in newborns

Definition:- Anemia is defined as a hemoglobin (Hgb) or hematocrit (HCT) that is more than 2 standard deviation below for the age or less than normal range for postnatal age and birth weight.(For clinical purpose HCT < 45% in the 1st week of life) .

Causes of neonatal anemia

- Blood loss
- Hemolytic anemia
- Diminished RBC production

Clinical approach to a newborn with anemia

- Detailed obstetric history.

- Physical examination
- Look for acute blood loss: shock, tachycardia, poor capillary refill time, poor perfusion and acidosis.
- Chronic blood loss associated with pallor, jaundice, hepatosplenomegaly, cardiac failure.
- Growing preterm baby may manifest with poor weight gain, apnea, tachypnea or poor feeding.

Investigations

- Complete blood cell count
- Blood group and RH of the newborn and mother.
- Reticulocye production index
- Blood smear to see the morphology and find evidence for hemolysis (target cells and burr cells).
- Coombs' test and bilirubin level.
- Apt test in case of gastro-intestinal bleeding to differentiate swallowed maternal blood from neonatal bleeding.
- Ultrasound of abdomen and head.
- Screening for infections [(TORCH) toxoplasmosis, rubella, cytomegalovirus infection, herpes simplex infection] and septicemia.
- Bone marrow aspiration (rarely used).

Management

Indications for blood transfusion

- In sever cardiopulmonary disease: Transfuse if HCT <40%
- For moderate respiratory distress: Transfuse if HCT < 30%
- For major surgery: Transfuse if HCT <30%
- Infant with asymptomatic anemia: Transfuse if HCT <21%
- If the newborn is in shock refer to the guideline on management of shock.

Guideline for packed RBC replacement in high risk neonates:

Volume of Packed red blood cell to be transfused can be calculated as follows:

Volume of transfusion =

$$\frac{\text{Weight in Kg} \times \text{blood volume / Kg} \times (\text{desired HCT} - \text{observed HCT})}{\text{HCT of blood to be given}}$$

- Average HCT of packed RBC is in the range 70-80%
- Transfuse over 2-4 hours time
- The average blood volume for term newborn is 85 ml/kg: 95ml/kg in preterm.
- Preferably transfuse fresh blood (<7 days old) to avoid related complications (decreased PH (7.4 Vs 6.5), elevated potassium level (4.2mM Vs 78.5mM) and decreased 2, 3- diphosphoglyserate.)
- Exchange transfusion with packed RBCs may be required for severely anemic infant if direct transfusion result in circulatory overload.

Whole blood transfusion

- If packed RBC is not available give whole blood 15-20 ml/kg over 2-3 hours period
- In case of acute blood loss use whole blood 15-20ml/kg over 1-2 hours period.
- Give Fusemide 1mg/kg pre and post transfusion.
- If Anemia is due to blood loss and newborn is asymptomatic give Iron drops

3.14.4 Hypoglycemia

Definition: Serum glucose level less than 50mg/dl

Risk factors for hypoglycemia

- Prematurity
- Intrauterine growth retardation
- Infant of diabetic mother
- Delayed initiation of feeding

Common clinical manifestations

- CNS irritability manifested by jitteriness , course tremor, twitching and convulsion
- Episodes of apnea with cyanosis and tachypnea with irregular breathing (mainly in preterm)
- Tachycardia and sweating (excess catecholamine secretion)

Management

- Establish IV line , give mini bolus 2ml/kg of 10%glucose iv (4ml/kg if baby has convulsion)
- Infuse 10% glucose at a rate of 6mg/kg/min

- Check blood glucose every 15min and if blood glucose is still low increase the rate with 2mg/kg/min every 15 min to a maximum of 12-14mg/kg/min
- If blood glucose is normal at two consecutive time check every one hour twice then every two hours twice then every four hours
- Unless there is contraindication start feeding the baby with expressed breast milk
- When blood glucose level remained normal for 12hours or blood glucose exceed 100 mg /dl decrease the infusion rate by 2mg/kg and check blood glucose every 6hrs. Once infusion rate is brought down to 4mg/kg /min, increase the feed and taper infusion fluid

3.14.5 Congenital malformations (see chapter 9)

- Cleft lip and palate (see chapter 9 section congenital anomalies)
- Bowel obstruction
- Abdominal wall defects
- Meningomyelocele
- Congenital dislocation of the hip
- Talipes equinovarus (club foot)

3.14.6 Large for gestational age (LGA) infants

Definitions

Large for Gestational Age (LGA): a baby with a birth weight > 90th percentile for gestational age.

Macrosomia: babies with a birthweight > 4000g.

Causes

- Maternal diabetes
- Genetics: “big parents - big baby”

- Excessive maternal weight: “fat mother - fat baby”
- Rare genetic disorders e.g. Beckwith-Wiedemann Syndrome

Complications and Risks

- Antenatal and Intrapartum risks
  - Increased still birth rate (8x in IDM’s)
  - Obstructed labour and shoulder dystocia
  - Fetal distress
- Neonatal
  - Birth trauma (fractures of clavicle/humerus; brachial plexus injury)
  - hypoxic-ischaemic damage
  - Hypoglycemia (in all, but especially in IDM’s)
- In addition, in IDM’s: Immature lungs with RDS, polycythaemia, Neonatal Jaundice, Cardiac defects, Asymmetrical ventricular septal hypertrophy with left and/or right HOCM, VSD. Rare: sacral agenesis; microcolon
- Long-term: increased risk of type I and type II diabetes in baby

Management

- Delivery is high risk: expect and manage complications
- Examine for: Birth trauma , Dysmorphia , Macrosomia ,Plethora ,Cardiac murmurs and RDS
- Manage hypoglycaemia: Feed within 30 minutes of birth (unless severe RDS or intrapartum hypoxia). Low blood sugar readings on a glucometer MUST be confirmed by a laboratory test.
- Do blood glucose 1 hr post-delivery:

- Continue frequent breast feeding 2-3hrly continue 3hrly blood glucose tests for 24 hours

3.14.7 Respiratory distress

Respiratory distress is an extremely common neonatal problem, with a limited number of common causes. The cornerstone of management is oxygen, not forgetting the other basics of warmth, food/glucose, and infection prevention and management

Definition: Respiratory distress is marked by one or more of the following signs (listed in increasing severity)

- Respiratory rate > 60/minute (tachypnoea/fast breathing)
- Recession or indrawing of the chest
- Flaring of Ala nasae
- Grunting
- Cyanosis
- Irregular breathing, then apnoea

Assessment of severity

- Mild: Respiratory rate > 60/minute with minimal (< 30%) oxygen requirements
- Moderate: Respiratory rate > 60/minute, recessing, flaring, cyanosis (requiring up to 60% oxygen)
- Severe: Respiratory rate > 60/minute, grunting, cyanosis (requiring > 60% oxygen), irregular respiration (progressing to apnoea).

If oxygen requirements go above 60%, baby may need ventilatory support

Common causes of respiratory distress in the newborn

Pulmonary causes

- Hyaline membrane disease (HMD)
- Meconium aspiration syndrome
- Wet lung syndrome
- Pneumonia
- Pneumothorax

Extra pulmonary causes

- Congenital heart disease/heart failure
- Hypothermia

Metabolic acidosis

- Anaemia and polycythaemia
- Diaphragmatic hernia
- Upper GIT anomalies (e.g. trache-oesophageal fistula)

Investigations

- Chest X-ray (wait 4-6 hours if hyaline membrane disease or transient tachypnoea of the newborn (TTN) are suspected)
- Gastric aspirate for a shake test and gram stain
- Full Blood Count, CRP and glucose
- Transilluminate the chest if a pneumothorax is suspected

Management

Oxygen

Give enough oxygen to keep the oxygen saturation between 85 and 93%. If you do not have a pulse oximeter ensures that the baby's tongue is pink. You MUST get one in your nursery FOR THE BABIES. If it is not possible to keep the infant pink in oxygen then continuous positive pressure (CPAP) via nasal prongs or endotracheal tube should be given – discuss referring your patient

- Monitor oxygen saturation

Supportive Care

- Keep the infant warm in an incubator

If the respiratory distress is mild, do intermittent KMC provided that he/she maintains oxygen saturation (85-93%) on nasal cannula oxygen

- Keep the neonate NPO per mouth for the first 24 hours
- Observe the RR, saturation, HR hourly, and check the blood glucose 3 hourly

Complications

It is important to watch out for:

- Anaemia of immaturity: Transfuse preterm babies if their Hb is less than 9gm%.
- In small babies, check pulses daily, and if they are bounding, listen for a murmur. Refer to a regional hospital if a PDA is present, and reduce intake to 120ml/kg/day
- Sepsis Neonatorum: Babies in KMC are less likely to acquire infections, but they are still at risk. At any sign of infection, fully and carefully assess baby, and manage accordingly

3.15 Babies of mothers with infections

3.15.1 Congenital syphilis

If the mother is VDRL reactive during ANC and treated with non penicillin drug, consider congenital syphilis and treat the baby with penicilin for 10-14 days.

Clinical signs

- Often low birth weight
- Palms and soles: red rash, grey patches, blisters or skin peeling
- 'Snuffles': rhinitis with nasal obstruction which is highly infectious
- Abdominal distension due to big liver and spleen
- Jaundice
- Anaemia
- Some VLBW babies with syphilis have signs of severe sepsis with lethargy, respiratory distress, skin petechiae or other bleeding

Diagnosis: If you suspect syphilis, do serum and CSF VDRL

Treatment

The diagnosis of neurosyphilis in the newborn with syphilitic infection is difficult because of the poor sensitivity of the CSF VDRL in this age group and the lack of CSF abnormalities. In general a positive CSF VDRL in newborn warrants treatment for neurosyphilis, even though it might reflect passive transfer of antibodies from serum to CSF. It is now accepted that all infants with presumptive diagnosis of congenital syphilis should be treated with regimen effective for neurosyphilis because this cannot be reliably excluded.

- *Prefered treatment is* - Benzyl penicillin 50,000 units/kg every 12 hours IM or IV for the first 7 days of life and then every 8 hours for a further 3 days (total of 10 days), Or
- Procaine penicillin 50,000 units/kg as a single dose daily for 10 days
- Screen and treat parents for syphilis and HIV according to the national guideline

NB: If >1 day of therapy is missed, the entire course should be started. A complete evaluation (CSF analysis, bone X-ray, CBC) is not necessary if 10 days of parenteral therapy is administered but may be useful to support a diagnosis of congenital syphilis.

3.15.2 Baby of a mother with tuberculosis

If the mother has active lung tuberculosis and was treated for less than two months before birth or was diagnosed with tuberculosis after birth:

- Reassure the mother that it is safe for her to breastfeed her baby; Investigate the baby for possible congenital tuberculosis& Screen the mother for HIV infection
- Do not give the tuberculosis vaccine (BCG) at birth; Give prophylactic isoniazid 5 mg/kg body weight by mouth once daily;
- At the age of six weeks, re-evaluate the baby, noting weight gain and taking an X- ray of the chest, if possible;
- If there are any findings suggestive of active disease, start full anti-tuberculosis treatment according to national guidelines;
- If the baby is doing well and tests are negative, continue prophylactic isoniazid to complete six months of treatment;
- Delay BCG vaccine until two weeks after treatment is completed. If BCG was already given, repeat BCG two weeks after the end of the isoniazid treatment.

3.15.3 Baby of a mother with HIV infection (see Chapter 8)

3.15.4 Baby of a mother with hepatitis B virus infection

Perinatal exposure to a HBsAg-positive mother is the most important risk factor for acquisition of HBV in children. The risk of transmission is greatest if the mother also is HBeAg positive. Nearly 70–90% of their infants

become chronically infected if untreated. Transmission can occur intrauterine but most commonly at delivery. HBsAg has been demonstrated inconsistently in human milk of infected mothers. However, breast-feeding of unimmunized infants by infected mothers does not appear to confer a greater risk of hepatitis on offspring than does formula feeding

Prevention

- Screen mothers for HBV infection during ANC visit
- Immunize new born at delivery (post exposure. See Table 3.3 below)
- Post vaccination testing for HBsAg and anti-HBs should be at 9–15 mo to know the status of the infant if possible
- Screen partner for HBV and HIV

Table 3.3 Indications and Dosing Schedule for Hepatitis B Vaccine and Hepatitis B Immune Globulin

Neonate	Vaccine		HBIG	
	Engerix-B (μg)	Schedule	Dose (μL)	Schedule
Infants of HBsAg-positive women	10	Birth, 1, 6 mo	0.5	Within 12 hr of birth
Infants of HBsAg-negative women	10	Birth, 1–2, 6–18 mo	None	

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3.14 Doses of common drugs for neonates and low-birth-weight infants

Drug	Dosage	Form	Weight of infant in kg						
			1–< 1.5	1.5–< 2	2–2.5	2.5–< 3	3–3.5	3.5–< 4	4–< 4.5
Aminophylline to prevent apnoea	Calculate the **exact** oral maintenance dose								
	Loading dose: Oral or IV over 30 minutes 6 mg/kg, then	250 mg/10 ml vial. Dilute loading dose to 5 ml with sterile water, give slowly over 15–30 min	0.6 ml	0.8 ml	1.0 ml	Aminophylline is not usually used for term infants.			
	Maintenance dose: First week of life: Oral: 2.5 mg/kg every 12 h		0.1–0.15 ml	0.15–0.20 ml	0.20–0.25 ml				
	Weeks 2–4 of life: Oral: 4 mg/kg every 12h		0.15–0.2 ml	0.25–0.3 ml	0.30–0.4 ml				
Ampicillin	IM/IV: 50 mg/kg First week of life: every 12 h Weeks 2–4 of life: every 8 h	Vial of 250 mg mixed with 1.3 ml sterile water to 250 mg/1.5 ml	0.3–0.6 ml	0.6–0.9 ml	0.9–1.2 ml	1.2–1.5 ml	1.5–2.0 ml	2.0–2.5 ml	2.5–3.0 ml
Caffeine citrate	Calculate the **exact** oral maintenance dose								
	Loading dose: Oral: 20 mg/kg (or IV over 30 min)		20–30 mg	30–40 mg	40–50 mg	50–60 mg	60–70 mg	70–80 mg	80–90 mg
	Maintenance dose: 5 mg/kg daily oral (or IV over 30 min)		5–7.5 mg	7.5–10 mg	10–12.5 mg	12.5–15 mg	15–17.5 mg	17.5–20 mg	20–22.5 mg

3. YOUNG INFANTS

Drug	Dosage	Form	Weight of infant in kg						
			1–<1.5	1.5–<2	2–2.5	2.5–<3	3–3.5	3.5–<4	4–<4.5
Cefotaxime	IV: 50 mg/kg Premature infants: every 12 h First week of life: every 8 h Weeks 2–4 of life: every 6 h	Vial of 500 mg mixed with 2 ml sterile water to 250 mg/ml	0.3 ml	0.4 ml	0.5 ml	0.6 ml	0.7 ml	0.8 ml	0.9 ml
Ceftriaxone For meningitis	IV: 50 mg/kg every 12 h	1-g vial mix with 9.6 ml sterile water to 1 g/10 ml	0.5–0.75 ml	0.75–1 ml	1–1.25 ml	1.25–1.5 ml	1.5–1.75 ml	1.75–2 ml	2–2.5 ml
	IM/IV: 100 mg/kg once a day		1–1.5 ml	1.5–2 ml	2–2.5 ml	2.5–3 ml	3–3.5 ml	3.5–4 ml	4–4.5 ml
For pus draining from eye	50 mg/kg once IM (max, 125 mg)								
Cloxacillin	25–50 mg/kg per dose First week of life: every 12 h	25-mg vial mixed with 1.3 ml sterile water to 250 mg/1.5 ml	**25 mg/kg:** 0.15–0.3 ml	0.3–0.5 ml	0.5–0.6 ml	0.6–0.75 ml	0.75–1.0 ml	1.0–1.25 ml	1.25–1.5 ml
	Weeks 2–4 of life: every 8 h		**50 mg/kg:** 0.3–0.6 ml	0.6–0.9 ml	0.9–1.2 ml	1.2–1.5 ml	1.5–2.0 ml	2–2.5 ml	2.5–3.0 ml

Drug	Dosage	Form	Weight of infant in kg						
			1–< 1.5	1.5–< 2	2–2.5	2.5–< 3	3–3.5	3.5–< 4	4–< 4.5
Gentamicin	Preferably calculate exact dose based on the infant's weight								
	First week of life: Low-birth-weight infants: IM/IV: 3 mg/kg once a day Normal birth weight: IM/IV: 5 mg/kg per dose once a day	Vial 20 mg/2 ml Vial 80 mg/2 ml Dilute to 8 ml with sterile water to 10 mg/ml	0.3–0.5 ml	0.5–0.6 ml	0.6–0.75 ml	1.25–1.5 ml	1.5–1.75 ml	1.75–2 ml	2–2.25 ml
	Weeks 2–4 of life: IM/IV: 7.5 mg/kg once a day		0.75–1.1 ml	1.1–1.5 ml	1.5–1.8 ml	1.8–2.2 ml	2.2–2.6 ml	2.6–3.0 ml	3.0–3.3 ml
Note: To use a vial of 80 mg/2 ml, dilute to 8 ml with sterile water to 10 mg/ml, then use exactly the same dose as in the table above.									
Kanamycin	IM/IV: 20 mg/kg (one dose for pus draining from eyes)	2-ml vial to make 125 mg/ml	0.2–0.3 ml	0.3–0.4 ml	0.4–0.5 ml	0.5–0.6 ml	0.6–0.7 ml	0.7–0.8 ml	0.8–1.0 ml
Naloxone	0.1 mg/kg	Vial 0.4 mg/ml	0.25 ml	0.25 ml	0.5 ml	0.5 ml	0.75 ml	0.75 ml	1 ml
PENICILLIN									
Benzylpenicillin	50 000 U/kg per dose **First week of life:** every 12 h **Weeks 2–4 and older:** every 6 h	Vial of 600 mg (1 000 000 U) dilute with 1.6 ml sterile water to 500 000 U/ml	0.2 ml	0.2 ml	0.3 ml	0.5 ml	0.5 ml	0.6 ml	0.7 ml

3. YOUNG INFANTS

Drug	Dosage	Form	Weight of infant in kg						
			1–< 1.5	1.5–<2	2–2.5	2.5–< 3	3–3.5	3.5–< 4	4–< 4.5
Benzathine benzylpenicillin	50 000 U/kg once a day	IM: vial of 1 200 000 U mixed with 4 ml sterile water	0.2 ml	0.3 ml	0.4 ml	0.5 ml	0.6 ml	0.7 ml	0.8 ml
Procaine benzylpenicillin	IM: 50 000 U/kg once a day	3-g vial (3 000 000 U) mixed with 4 ml sterile water	0.1 ml	0.15 ml	0.2 ml	0.25 ml	0.3 ml	0.3 ml	0.35 ml
Phenobarbital	**Loading dose:** IM/IV or oral: 20 mg/kg	Vial 200 mg/ ml diluted with 4 ml sterile water	Calculate the **exact** dose						
		30-mg tablets	½	¾	1	1¼	1½	1¾	2
	Maintenance dose: Oral: 5 mg/kg per day	30-mg tablets	¼	¼	½	½	½	¾	¾

CHAPTER- 4 - COUGH OR DIFFICULT BREATHING

Cough and difficult breathing are common problems in young children. The causes range from a mild, self-limited illness to severe, life-threatening disease. This chapter provides guidelines for managing the most important conditions that cause cough, difficult breathing, or both in children aged 2 months to 5 years.

The differential diagnosis of these conditions is described in Chapter 1. Management of these problems in infants less than 2 months of age is described in chaprter 3 and Management in severely malnourished children is described in Chapter 7.

Most episodes of cough are due to common cold, with each child having several episodes a year. The commonest severe illness presenting with cough or difficult breathing is pneumonia, which should be considered first as any differential diagnosis.

4.1 Child presenting with cough

History

Pay particular attention to the following:

Cough

- duration in days
- paroxysms with whoops or vomiting or bluish discoloration of lips (central cyanosis)
- associated symptoms like hoarseness of voice, runny nose, fever, difficulty of breathing, wheezing, etc
- history of contact with chronic cougher or patient with tuberculosis in the family
- history of choking or sudden onset of stridor and fast breathing (respiratory distress)
- Presence of any other danger sign like child not able to drink or vomits everything, has convulsions or is lethargic or unconscious

- known or possible HIV infection
- immunization history: BCG, DPT, measles, Hib and pneumococcus
- personal or family history of asthma or allergy
- Social history (family size, exposure to smoke etc)

Examination

The symptoms and signs listed below are a guide to the clinician to reach a diagnosis. Not all children will show every symptom or sign.

General

- presence of convulsion
- presence of lethargy or unconsciousness
- central cynosis
- head nodding (a movement of the head synchronous with inspiration indicating severe respiratory distress)
- apnea, gasping, grunting, fast breathing, nasal flaring, audible wheezing, stridor
- severe palmar pallor

Vital signs - respiratory rate, pulse rate/AHR, temperature, BP

- RR – make a count for a full minute when the child is calm

Fast breathing: Age <2 months old: ≥ 60 breaths*
Age 2–11 months: ≥ 50 breaths
Age 1–5 years: ≥ 40 breaths

***** If the breathing rate is 60 or more repeat counting the breathing rate in young infants for a full minute

Chest

- lower chest wall indrawing (it occurs when the lower chest wall goes in when the child breathes in)
- hyperinflated chest
- visible distended veins on the neck
- apex beat displaced / trachea shifted from midline
- percussion-signs of pleural effusion (stony dullness) or pneumothorax (hyper-resonance)

- on auscultation coarse crackles, bronchial breath sounds, decreased or absent air entry or wheezing

Note: *lower chest indrawing is when the lower chest wall goes in when the child breathes in*.

Heart

- raised jugular venous pressure (JVP)
- gallop rhythm / murmur of heart on auscultation
- distant heart sound

Abdomen

- enlarged liver and spleen.
- abdominal masses other than liver or spleen
- sign of fluid in the peritoneum (ascites)

Skin

- sever palmar pallor
- rashes (petechiae, ecchymosis)

Extremity

- clubbing of finger nails
- peripheral edem

Investigations

- pulse oximetry–to guide when to start and stop oxygen therapy
- full blood count
- chest X-ray: in children with very severe pneumonia, or severe pneumonia not responding to treatment or with complications, unclear diagnosis or associated with HIV
- sputum for AFB (for children old enough to expectorate) or gastric aspirate

Table 4.1 Differential diagnosis of the child presenting with cough or difficulty in breathing

Diagnosis	In favour
Pneumonia	Cough with fast breathing Fever Nasal flaring Grunting Head nodding Lower chest wall indrawing Coarse crackles on auscultation
Malaria	Lives in or travelled to a malarious area Fast breathing in febrile child In severe malaria: deep (acidotic) breathing / lower chest wall indrawing Chest clear on auscultation Blood smear or positive for malaria parasite, or RDT positive
Severe anaemia	Shortness of breath on exertion Severe palmar pallor Haemoglobin <6 g/dl
Cardiac failure	Fast breathing, feeding interruption, cyanosis Growth failure Raised jugular venous pressure Fine crackles on the bases of the lung fields Apex beat displaced to the left Gallop rhythm Heart murmur (in some cases) Enlarged palpable liver Clubbing of finger nails Edema of extremities
Congenital heart disease (cyanotic)	Cyanosis Finger clubbing Heart murmur Signs of cardiac failure (in some cases) Failure to thrive
Congenital heart disease	Difficulty in feeding or breastfeeding with failure to thrive Sweating of the forehead

(acyanotic)	Heaving precordium Heart murmur (in some cases) Signs of cardiac failure
Tuberculosis	Chronic cough (more than 2 weeks), history of contact with chronic cougher or known TB patient Poor growth / wasting or weight loss Diagnostic: chest X-ray may show primary complex or miliary tuberculosis, effusion, cavity Sputum or gastric aspirate positive for AFB
Pertussis	Paroxysms of cough followed by whoop, or vomiting, cyanosis or apnoea Well between bouts of cough No fever No history of PENTA immunization or incomplete immunization
Foreign body	History of sudden choking Sudden onset of stridor or respiratory distress Focal areas of wheeze or reduced breath sounds Chest X-ray finding
Effusion or empyema	Reduced movement on the attected side of chest Stony dullness to percussion (over the effusion) Air entry absent (over the effusion) Chest X-ray finding
Pneumothorax	Sudden onset, usually after major chest trauma Hyper-resonance on percussion on one side of the chest Shift of mediastinum to opposite side Chest X-ray finding
Pneumocystis Pneumonia (PCP)	HIV test positive in mother or child 2-6 month old child with central cyanosis Fast breathing Hyper-expanded chest Chest clear on auscultation Enlarged lymph nodes, liver and spleen Finger clubbing Chest X-ray changes

Asthma or wheeze	Recurrent episodes of shortness of breath or wheez Night cough or cough and wheeze with exercise Response to bronchodilators Known or family history of allergy or asthma
Bronchiolitis	Cough Wheeze and crackles Age usually < 1 year
Severe Anaemia	Shortness of breath on exertion Severe palmar pallor Hb < 6 g/dl
Croup	Inspiratory stridor Barking character to cough Hoarse voice

4.2 Pneumonia

Pneumonia is usually caused by viruses or bacteria. Most serious episodes are caused by bacteria. It is usually not possible, however, to determine the specific cause by clinical features or chest X-ray appearance. Pneumonia is classified as severe or non-severe, based on the clinical features. The management is based on the classification. Antibiotic therapy is needed in all cases. Severe pneumonia requires additional treatment, such as oxygen, to be given in hospital.

Table 4.2 Classification of the severity of pneumonia

Sign or symptom	Classification	Treatment
Cough or diffi culty in breathing with: • Oxygen saturation < 90% or central cyanosis • Severe respiratory distress e.g. grunting, severe chest indrawing • Signs of pneumonia with • a general danger sign (inability to breastfeed or drink, lethargy or reduced level of consciousness, convulsions)	**Severe Pneumonia**	• Admit to hospital • Give oxygen if saturation is < 90% • Manage the airway • Give recommended antibiotic • Treat high fever if present
• Fast breathing ≥ 60 breaths/minute in a Child aged <2 months; ≥ 50 breaths/ minute in a child aged 2–11 months ≥ 40 breaths/minute in a child aged 1–5 years OR • Chest indrawing • Definite chest findings on auscultation	**Pneumonia**	▪ Home care ▪ Give appropriate antibiotic for 5 days ▪ Soothe the throat and relieve cough with a safe remedy • Advise the mother when to return immediately • Follow up in 2 days
• No signs of pneumonia or severe pneumonia	**No pneumonia: Cough or cold**	• Soothe the throat and relieve cough with safe remedy • Advise the mother when to return • Follow up in 5 days if not improving • If coughing for more than 3 weeks, follow chronic cough instructions

4.2.1 Severe pneumonia

Diagnosis

Cough or difficult breathing plus at least one of the following:

- Central cyanosis or oxygen saturation < 90 on pulse oxymetry
- Severe respiratory distress (fast bqreathing, nasal flaring, grunting
- Lower chest wall indrawing
- Signs of pneumonia with a general danger sign

In addition, some or all of the other signs of pneumonia may be present
Additional auscultatory findings include:

- Abnormal vocal resonance (decreased over a pleural effusion, increased over lobar consolidation
- Decreased breath sounds, bronchial breath sounds, crackles, pleural rub.

Investigation

- Obtain an oxygen saturation measurement in all children suspected to have severe pneumonia
- If possible, obtain a chest X-ray to identify pleural effusion, empyema, pneumo thorax, pneumatocoele, interstitial pneumonia and pericardial effusion.

Treatment

Admit the child to hospital.

Oxygen therapy

- Give oxygen to all children with severe pneumonia
- Where pulse oximetry is available, use this to guide oxygen therapy (give to children with oxygen saturation less than 90%)
- Use nasal prongs, a nasal catheter, or a nasopharyngeal catheter. Use of nasal prongs is the best method for delivering oxygen for young infants
- Face masks or head masks are not recommended.

Oxygen supplies need to be available continuously at all times. A comparison of the different methods of oxygen administration and diagrams showing their use is given in chapter 10.

- Continue with oxygen until the signs of hypoxia (such as severe lower chest wall indrawing, inability to breast feed or breathing rate of ≥ 70/minute) are no longer present.
- Where pulse oximetry is available, carry out a trial period without oxygen each day in stable children. Discontinue oxygen if the saturation remains stable above 90% (atleast 15 minutes on room air). There is no value in giving oxygen after this time.
- Nurses should check every 3 hours that the catheter or prongs are not blocked with mucus and are in the correct place and that all connections are secure. The two main sources of oxygen are cylinders and oxygen concentrators. It is important that all equipment is checked for compatibility and properly maintained, and that staff are instructed in their correct use.

Antibiotic therapy

- Give ampicillin (50 mg/kg IV/IM every 6 hours) or benzylpenicillin (50,000 u/kg IV or IM every 6 hours) for 3- 5 days; then, if child responds well, complete treatment at home or in hospital with oral amoxicillin (25-50 mg/kg three times a day)
- Use ceftriaxone (80 mg/kg IM or IV once daily) in cases of failure of first line therapy.

Supportive care

- If the child has fever (≥ 39 ° C) which appears to be causing distress, give Paracetamol.
- If wheeze is present, give a rapid-acting bronchodilator (nebulized salbutamol, salbutamol by metered dose inhaler with a spacer device or subcutaneous epinephrine) and start steroids when appropriate.
- Remove by gentle suction any thick secretions in the throat, which

the child cannot clear.

- Ensure that the child receives daily maintenance fluids appropriate for the child's age but avoid overhydration (section 10.2).
- Encourage breastfeeding and oral fluids.
- If the child cannot drink, insert a nasogastric tube and give maintenance fluids in frequent small amounts. If the child is taking fluids adequately by mouth, do not use a nasogastric tube as it increases the risk of aspiration pneumonia and obstructs part of the nasal airway. If oxygen is given at the same time as nasogastric fluids, pass both tubes through the same nostril.
- Encourage the child to eat as soon as food can be taken.

Monitoring

The child should be checked by nurses at least every 3 hours and by a doctor at least twice a day. In the absence of complications, within two days there should be signs of improvement (breathing slower, less indrawing of the lower chest wall, less fever, and improved ability to eat and drink, better oxygen saturation).

Complications or other diagnoses to be considered

If the child has not improved after two days, or if the child's condition has worsened, look for complications or other diagnoses. If possible, obtain a chest X-ray. The commonest other possible diagnoses are:

Staphylococcal pneumonia. This is suggested if there is rapid clinical deterioration despite treatment, by a pneumatocoele or pneumothorax with effusion on chest X-ray, numerous Gram-positive cocci in a smear of sputum, or heavy growth of S. aureus in cultured sputum or empyema fluid. The presence of septic skin pustules supports the diagnosis.

Treat with cloxacillin (50 mg/kg IM or IV every 6 hours) and gentamicin (7.5 mg/kg IM or IV once a day). When the child improves (after altleast 7 days of IV or IM antibiotics), continue gentamycin IM daily for a total of 10 days and cloxacillin orally 4 times a day for a total course of 3 weeks. Note that cloxacillin can be substituted by another anti-staphylococcal antibiotic such

as vancomycin, flucloxacillin or dicloxacillin

Empyema: This is suggested by persistent fever, and physical and chest X-ray signs of pleural effusion.

Tuberculosis: A child with persistent cough and fever for more than 2 weeks and signs of pneumonia should be evaluated for tuberculosis. If another cause of the fever cannot be found, tuberculosis should be considered and treatment for tuberculosis, following national guidelines, may be initiated and response to anti-Tb treatment evaluated.

The HIV status of all children should be confirmed if not known.

HIV infection or exposure to HIV. Some aspects of antibiotic treatment are different for children who are HIV positive or in whom HIV infection is suspected.Although pneumonia in many of these children has the same etiology as that in children without HIV, Pneumocystis pneumonia (PCP), often at the age of 4–6 months (see chapter 8) is an important cause to be suspected and treated.

Treat as for severe pneumonia above; give ampicillin plus gentamicin IM or IV for 10 days.

If the child does not improve within 48 h, switch to ceftriaxone at 80 mg/kg IV once daily over 30 min. If ceftriaxone is not available, give gentamicin plus cloxacillin, as above.

For children < 12 months, also give high-dose co-trimoxazole (8 mg/kg trimethoprim and 40 mg/kg sulfamethoxazole IV every 8 hours or orally three times a day) for 3 weeks. For a child aged 12–59 months, give this treatment only if there are clinical signs of PCP
(Such as chest X-ray findings of interstitial pneumonia).

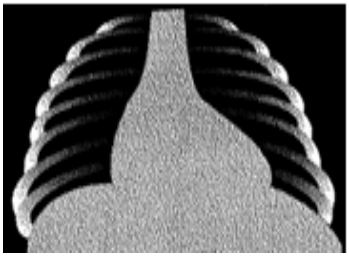


Figure 4.1.A: Normal Chest X-ray

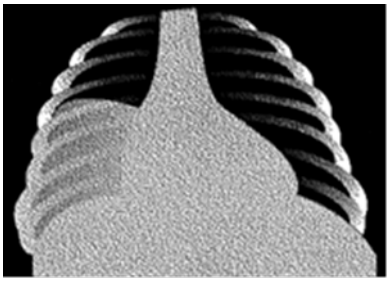


Figure 4.1.B: Lobar pneumonia of the right lower zone indicated by a consolidation

For further management of the child, including PCP prophylaxis, see Chapter 8.

Staphylococcal pneumonia: Typical features include pneumatocoeles on the right side of the illustration, and an abscess with an air-fluid level on the left side of the illustration (Fig 4.1.C).

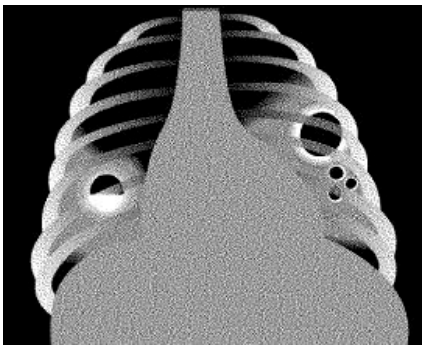
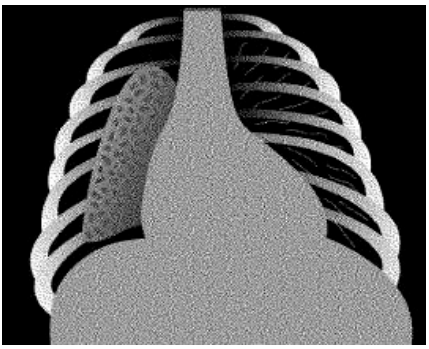


Figure 4.1.C: Staphylococcal pneumonia



Fifure 4.1.D: Pneumothorax

Pneumothorax: The right lung is collapsed towards the hilus, leaving a transparent margin around it without lung structure. In contrast, the right side demonstrates markings extending to the periphery (Fig 4.1.D).

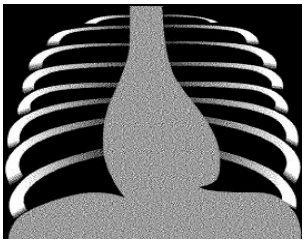


Figure 4.1.E: Hyperiflated chest

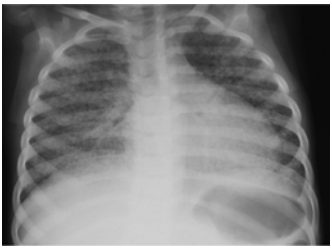


Figure 4.1.F: Miliary TB

Hyperinflated chest: Features are an increased transverse diameter, ribs running more horizontally, a small contour of the heart, and flattened diaphragms (Figure 4.1.E).

Appearance of **miliary tuberculosis**: widespread small patchy infiltrates throughout both lungs: "snow storm appearance" (Fig 4.1.F).

Discharge

Children with severe pneumonia can be discharged when:

- Respiratory distress has resolved.
- There is no hypoxaemia (oxygen saturation, > 90%).
- They are feeding well.
- They are able to take oral medication or have completed a course of parenteral antibiotics.
- The parents understand the signs of pneumonia, risk factors and when to return.

Follow-up

Children with severe pneumonia may cough for several weeks. As they havebeen very sick, their nutrition is often poor. Give the vaccinations that are due, and arrange follow-up 2 weeks after discharge, if possible, to check the child's. Also address risk factors such as malnutrition, indoor air pollution and parental smoking.

4.2.2. Pneumonia (non-severe)

Diagnosis

Cough or difficult breathing plus at least one of the following signs:

- Fast breathing: age 2–11 months, ≥ 50/min
  age 1–5 years, ≥ 40/min

In addition, either crackles or pleural rub may be present on chest auscultation.

Check that there are no signs of severe pneumonia, such as:

- Oxygen saturation < 90% on pulse oximetry or central cyanosis
- Severe respiratory distress (e.g. grunting, very severe chest indrawing)
- Inability to breastfeed or drink or vomiting everything
- Convulsions, lethargy or reduced level of consciousness
- Auscultatory fi ndings of decreased or bronchial breath sounds or signs
- Of pleural effusion or empyema.

Treatment

- Treat the child as an outpatient.
- Advise carers to give normal fluid requirements plus extra breast milk or fluids if there is a fever. Small frequent drinks are more likely to be taken and less likely to be vomited
- Give the first dose at the clinic and teach the mother how to give the other doses at home

Antibiotic therapy

- Give oral amoxicillin:
- In settings with high HIV infection rate, give oral amoxicillin at least 40 mg/kg per dose twice a day for 5 days.
- In areas with low HIV prevalence, give amoxicillin at least 40 mg/kg per dose twice a day for 3 days. Avoid unnecessary harmful medications such as remedies containing atropine, codeine derivatives or alcohol

Follow-up

Encourage the mother to feed the child. Advise her to bring the child back after 3 days, or earlier if the child becomes sicker or is not able to drink or breastfeed. When the child returns, check:

- Whether the breathing has improved (slower), there is less fever, there is no chest indrawing and the child is eating better, complete the antibiotic treatment.
- If the breathing rate and/or chest indrawing or fever and/or eating have not improved, exclude a wheeze. If no wheeze, admit to hospital for investigations to exclude complications or alternative diagnosis.
- If signs of severe pneumonia are present, admit the child to hospital and treat as above.
- Address risk factors such as malnutrition, indoor air pollution and parental smoking.

Pneumonia in children with HIV infection

- Admit to hospital and manage as severe pneumonia (see section 4.2.1)
- For further management of these children, including PCP prophylaxis (see Chapter 8,).

4.3 Complications of pneumonia

Septicaemia is the most common pneumonia complication and occurs when the bacteria causing pneumonia spreads into the blood stream (see chapter 6). The spread of bacteria can lead to septic shock or metastatic secondary infections like meningitis especially in infants, peritonitis, and endocarditis especially in patients with valvulvar heart disease or septic arthritis. Other common complications include pleural effusion, empyema and lung abscess.

4.3.1 Pleural effusion and empyema

Diagnosis

A child with severe pneumonia or pneumonia may develop pleural effusion or empyema.

- On examination, the chest is dull to percussion and breath sounds are reduced or absent over the affected area.
- A pleural rub may be heard at an early stage before the effusion is fully developed.
- A chest X-ray shows fluid on one or both sides of the chest.
- When empyema is present, fever persists despite antibiotic therapy and the pleural fluid is cloudy or frankly purulent.

Treatment

Drainage

Pleural effusions should be drained, unless they are very small. If effusions are present on both sides of the chest, drain both. It may be necessary to repeat drainage 2–3 times if fluid returns. (See Appendix for guidelines on chest drainage). Where possible, pleural fluid should be analysed for protein and glucose content, cell count and differential, and examined after Gram and Ziehl-Neelsen staining and bacterial and Mycobaterium tuberculosis culture.

Antibiotic therapy

- Give ampicillin or cloxacillin (50 mg/kg IM or IV every 6 h) or vancomycin (20mg/kg IV evry 6 h) and gentamicin (7.5 mg/kg IM or IV once a day). When the child improves (after at least 7 days of IV or IM antibiotics), continue cloxacillin orally four times a day for a total course of 3 weeks.

Note: Cloxacillin is preferable if staphylococcal infection is suspected. Infection with S. aureus is more likely if pneumatocoeles are also present.

Antibiotic treatment depends on the culture and sensitivity result when it is available

Failure to improve

If fever and other signs of illness continue, despite adequate chest drainage and antimicrobial therapy, test for HIV infection and assess for possible tuberculosis.

- A trial of anti-TB therapy may be required (see chapter 4).

4.3.2 Lung abscess

A lung abscess is a circumscribed, thick-walled cavity in the lung that contains purulent material resulting from suppuration and necrosis of the involved lung parenchyma. It frequently develops in an unresolved area of pneumonia. This could be a result of pulmonary aspiration, diminished clearance mechanisms, embolic phenomena, or haematogenous spread.

Diagnosis

Common signs and symptoms:

- Fever
- Pleuritic chest pain
- Sputum production or haemoptysis
- Weight loss
- On examination: reduced chest movement, decreased breath sounds, dullness to percussion, crackles, and bronchial breathing.
- Chest X-ray: solitary, thick-walled cavity in the lung with or without air-fluid level.
- Ultrasonography and CT scan: to localize the lesion and guide drainage or needle aspiration.

Treatment

The choice of antibiotic is usually empirical and is based on the underlying condition of the patient and the presumed etiological agent.

- Give ampicillin or cloxacillin (50 mg/kg IM or IV every 6 h) or

vancomycin (20mg/kg every 6 h) and gentamicin (7.5 mg/kg IM or IV once a day). Continue treatment as in empyema (see chapter 4) for up to 3 weeks.

- Surgical management is considered in cases of large lung abscess especially when associated with haemoptysis or clinical deterioration despite appropriate antibiotic therapy. Drainage is usually through percutaneous tube drainage or ultrasound guided needle aspiration.

4.3.3 Pneumothorax

Pneumothorax is usually secondary to an accumulation of air in the pleural spaces from alveolar rupture or from infection with gas-producing microorganisms.

Diagnosis

- Signs and symptoms may vary according to the extent of lung collapse,degree of intrapleural pressure, and rapidity of onset.
- On examination: chest bulging on the affected side if one side is involved, shift of cardiac impulse away from the site of the pneumothorax, decreased breath sounds on the affected side, grunting, severe respiratory distress and cyanosis may occur late in the progression of the complication.
- Differential diagnosis include lung cyst, lobar emphysema, bullae, diaphragmatic hernia
- Chest X-ray is crucial in the confi rmation of diagnosis

Treatment

Insert needle for urgent decompression, before insertion of an intercostal chest drain. (See Annex for guidelines on chest drainage). Drainage is usually through percutaneous tube drainage or ultrasound guided needle aspiration.

4.4 Cough or cold

These are common, self-limited viral infections that require only supportive care. Antibiotics should not be given. Wheeze or stridor may occur in some

children, especially infants. Most episodes end within 14 days. Cough lasting 14 days or more may be caused by tuberculosis, asthma, pertussis or symptomatic HIV infection (see Chapter 8).

Diagnosis

Common features:

- cough
- nasal discharge
- breathing
- fever

Thefollowing signs should not be present:

- general danger signs.
- signs of severe pneumonia or pneumonia
- stridor when the child is calm
- wheezing may occur in young children (see below).

Treatment

- Treat the child as an outpatient.
- Soothe the throat and relieve the cough with a safe remedy, such as a warm, sweet drink, tea with honey, fruit juice, etc.
- Treat high fever (≥ 39 ° C) with paracetamol
- Clear secretions from the child's nose before feeds using a cloth soaked in water, which has been twisted to form a pointed wick.
- Give normal fl uid requirements plus extra breast milk or fl uids if there is fever.Small frequent drinks are more likely to be taken and less likely to be vomited.

Do not give any of the following:

- an antibiotic (they are not effective and do not prevent pneumonia)
- remedies containing atropine, codeine or codeine derivatives, or alcohol (these may be harmful)
- medicated nasal drops.

Follow-up

Advise the mother to:

- feed the child(increase frequency of breast feeding)
- watch for fast or difficult breathing and return, if either develops
- return if the child becomes more sick, or is not able to drink or breastfeed.

4.5 Conditions presenting with wheeze

Wheeze is a high-pitched whistling sound near the end of each expiration. It is caused by spasmodic narrowing of the distal airways. To hear a wheeze, even in mild cases, place the ear next to the child's mouth and listen to the breathing while the child is calm, or use a stethoscope.

In the first 2 years of life, wheezing is mostly caused by acute viral respiratory infections such as bronchiolitis or coughs and colds. After 2 years of age, most wheezing is due to asthma. Some children with pneumonia present with wheeze. It is important always to consider treatment for pneumonia particularly in the first 2 years of life.Children with wheeze but no fever, chest indrawing or danger signs are unlikely to have pneumonia and should therefore not be given antibiotics.

Diagnosis

History

- previous episodes of wheeze
- Family history of allergy/atopy or asthma
- response to bronchodilators
- asthma diagnosis or long-term treatment for asthma
- night-time or early morning shortness of breath, cough or wheeze.

Examination

- Shortness of breath at rest or on exertion
- wheezing on expiration
- prolonged expiration
- resonant percussion note

- hyperinflated chest
- Lower chest indrawing if severe
- Rhonchi on auscultation

Response to rapid-acting bronchodilator

- If the cause of the wheeze is not clear, or if the child has fast breathing or chest indrawing in addition to wheeze, give a rapid-acting bronchodilator and assess after 15 minutes. Response to a rapid-acting bronchodilator helps to determine the underlying diagnosis and treatment.
- Give the rapid-acting bronchodilator by one of the following methods:
  - nebulized salbutamol
  - salbutamol by a metered dose inhaler with spacer device (may use locally available plastic bottles)
  - if neither of the above methods is available, give a subcutaneous injection of epinephrine (adrenaline).
- Assess the response after 15 minutes. Signs of improvement are:
  - less respiratory distress (easier breathing)
  - less lower chest wall indrawing
  - improved air entry.
- Children who still have signs of hypoxia (i.e. central cyanosis, low oxygen saturation $\leq$ 90, not able to drink due to respiratory distress, severe lower chest wall indrawing) or have fast breathing should be admitted to hospital for further treatment.

Table 4.3 Differential diagnosis of the child presenting with wheeze

Diagnosis	In favour
Asthma	History of recurrent wheeze, some unrelated to coughs and colds Hyperinflation of the chest Prolonged expiration Reduced air entry (if very severe, airway obstruction) Good response to bronchodilators History of atopy / family history of asthma or atopy
Bronchiolitis	First episode of wheeze in a child aged <2 years Wheeze episode at time of seasonal bronchiolitis Hyperinflation of the chest Prolonged expiration Reduced air entry (if very severe, airway obstruction) Poor/no response to bronchodilators
Wheeze associated with cough or cold	Wheeze always related to coughs and colds \No family or personal history of asthma/eczema/hay fever Prolonged expiration Reduced air entry (if very severe, airway obstruction) Good response to bronchodilators Tends to be less severe than wheeze associated with asthma
Foreign body	History of sudden onset of choking or wheezing Wheeze may be unilateral Air trapping with hyper-resonance and mediastinal shift Signs of lung collapse: reduced air entry and impaired percussion note No response to bronchodilators
Pneumonia	Cough with fast breathing Lower chest wall indrawing Fever Coarse crackles Nasal flaring Grunting

4.5.1 Bronchiolitis

Bronchiolitis is a lower respiratory viral infection, which typically is most severe in young infants, occurs in annual epidemics, and is characterized by airways obstruction and wheezing. Respiratory syncytial virus is the most important cause. Secondary bacterial infection may occur. The management of bronchiolitis associated with fast breathing or other signs of respiratory distress is therefore similar to that of pneumonia. Episodes of wheeze may occur for months after an attack of bronchiolitis, but will eventually stop.

Diagnosis

Typical features of bronchiolitis, on examination, include:

- wheezing which is not relieved by up to three doses of a rapid-acting bronchodilator
- hyperinflation of the chest, with increased resonance to percussion
- lower chest wall indrawing
- fine crackles or wheezes on auscultation of the chest
- difficulty in feeding, breastfeeding or drinking owing to respiratory distress.
- Nasal discharge, which can cause severe nasal obstruction

Treatment

Most children can be treated at home, but those with the following signs of severe pneumonia should be treated in hospital.

- oxygen saturation < 90% or central cyanosis.
- apnoea or history of apnoea
- inability to breastfeed or drink, or vomiting everything
- convulsions, lethargy or unconsciousness
- gasping and grunting (especially in young infants).

Oxygen

- Give oxygen to all children with severe respiratory distress or oxygen saturation ≤ 90% (see section 4.2.1). The recommended method for delivering oxygen is by nasal prongs or a nasal catheter.

The nurse should check, every 3 hours, that the catheter or prongs are in the correct position and not blocked with mucus, and that all connections are secure.

Antibiotic treatment

- If the infant is treated at home, give amoxicillin (40 mg/kg twice a day) orally for 5 days only if the child has signs of pneumonia (fast breathing and lower chest wall indrawing).
- If there are signs of severe pneumonia, give ampicillin at 50 mg/kg or
- benzylpenicillin at 50 000 U/kg IM or IV every 6 h for at least 5 days and complete with PO amoxicilline for extra 5 days to complete a 10 day course

Supportive care

- If the child has fever (≥ 39 ° C) which appears to be causing distress, give paracetamol
- Ensure that the hospitalized child receives daily maintenance fluids appropriate for the child's age (see chapter 10), but avoid overhydration. Encourage breastfeeding and oral fluids.
- Encourage the child to eat as soon as food can be taken. Nasogastric feeding should be considered in any patient who is unable to maintain oral intake or hydration (expressed breast milk is the best).
- Gentle nasal suction should be used to clear secretions in infants where nasal blockage appears to be causing respiratory distress.

Monitoring

A hospitalized child should be assessed by a nurse every 6 hours (or every 3 hours, if there are signs of very severe illness) and by a doctor at least once a day. Monitor oxygen therapy Watch especially for signs of respiratory failure, i.e. increasing hypoxia and respiratory distress leading to exhaustion.

Complications

If the child fails to respond to oxygen therapy, or the child's condition worsens suddenly, obtain a chest X-ray to look for evidence of pneumothorax.

Tension pneumothorax associated with severe respiratory distress and shift of the heart requires immediate relief by placing a needle in the affected area to allow the air that is under pressure to escape (needle thoracentesis). Following this, continuous air exit should be assured by inserting a chest tube with an underwater seal until the air leak closes spontaneously and the lung expands).

Infection control

Bronchiolitis is very infectious and dangerous to other young children in hospital with other conditions. The following strategies may reduce cross-infection:

- hand-washing by personnel between patients
- ideally isolate the child, but maintain close observation
- during epidemics, restrict visits to children by parents and siblings with symptoms of upper respiratory tract infection.

Discharge

An infant with bronchiolitis can be discharged when respiratory distress and hypoxaemia have resolved, when there is no apnoea and the infant is feeding well.Infants are at risk for recurrent bronchiolitis if they live in families where adults smoke or if they are not breastfed. So, advise the parents against smoking.

Follow-up

Infants with bronchiolitis may have cough and wheeze for up to 3 weeks. As long as they are well with no respiratory distress, fever or apnoea and are feeding well they do not need antibiotics.

4.5.2 Asthma

Asthma is a chronic inflammatory condition with reversible airways obstruction. It is characterized by recurrent episodes of wheezing, often with cough, which respond to treatment with bronchodilators and anti-inflammatory drugs. Antibiotics should be given only when there are signs of pneumonia.

Diagnosis

History - recurrent episodes of wheezing, often with cough. diffi culty in breathing and tightness in the chest, particularly if these are frequent and recurrent or are worse at night and in the early morning. Findings on examination may include:

- Fast breathing
- Hypoxia (oxygen saturation $\leq$ 90%)
- absence of fever
- lower chest wall indrawing
- use of accessory muscles for breathing (best noted by looking at the muscles of the neck)
- prolonged expiration with audible wheeze
- reduced or no air entery when obstruction is life threatening
- hyperinflation of the chest
- usually good response to treatment with a bronchodilator.

If the diagnosis is uncertain, give a dose of a rapid-acting bronchodilator (see adrenaline/epinephrine and salbutamol. A child with asthma will usually improve rapidly, showing signs such as a decrease in the respiratory rate and in chest wall indrawing and less respiratory distress. A child with severe asthma may require several doses before a response is seen.

Table 4.4 Asthma Treatment Algorithm		
Mild Asthma	Moderate Asthma	Severe Asthma (life threatening)
Normal mental state Talks in sentences Little or no accessory muscle use SPO2>95% Wheeze + normal breath sounds	Normal to agitated mental state Talks in phrases Mild to moderate accessory muscle use SPO2 90-95% Wheeze + reduced breath sounds	Agitated or confused mental state Talk in single word or unable to talk Significant accessory muscle use SPO2<90% Wheeze +significantly reduce breath sounds
Note: If patient has sign or symptoms from two different categories, always treat according to the most sever feature		

Treatment

- A child with the first episode of wheezing and no respiratory distress can usually be managed at home with supportive care and with a bronchodilator.
- If the child is in respiratory distress (acute severe asthma) or has recurrent wheezing, give salbutamol by nebulizer or metered-dose inhaler. If salbutamol is not available, give subcutaneous epinephrine. Reassess the child after 15 minutes to determine subsequent treatment:
- If respiratory distress has resolved, and the child does not have fast breathing, advise the mother on home care with inhaled salbutamol from a metered dose and spacer devise (which can be made locally from plastic bottles).or, when this is not available, oral salbutamol syrup or tablets.
- If respiratory distress persists, admit to hospital and treat with oxygen, rapid-acting bronchodilators and other drugs, as described below.

Severe life-threatening asthma

- If the child has life-threatening acute asthma, is in severe

respiratory distress with central cyanosis or reduced oxygen saturation ≤ 90%, has poor air entry(silent chest), is unable to drink or speak or is exhausted and confused, admit to hospital and treat with oxygen, rapid-acting bronchodilators and other drugs, as described below.

- In children admitted to hospital, promptly give oxygen, a rapid-acting bronchodilator and a first dose of steroids.

Oxygen

- Give oxygen to keep oxygen saturation > 95% in all children with asthma who are cyanosed (oxygen saturation ≤ 90%) or whose difficulty in breathing interferes with talking, eating or breastfeeding.
- A positive response (less respiratory distress, better air entry on auscultation) should be seen in 15 minutes. If this does not occur, give the rapid-acting bronchodilator at up to 1-hourly intervals.
- If there is no response after 3 doses of rapid-acting bronchodilator, add IV aminophylline.

Rapid-acting bronchodilators

Give the child one of the three rapid-acting bronchodilators, nebulized salbutamol, salbutamol by metered-dose inhaler with a spacer device, or subcutaneous epinephrine (adrenaline), as described below.

1. Nebulized salbutamol

The driving source for the nebulizer must deliver at least 6–9 litres/minute. Recommended methods are an air compressor or oxygen cylinder. If neither is available, use a durable and easy-to-operate foot-pump, although this is less effective.

Place the bronchodilator solution and 2–4 ml of sterile saline in the nebulizer compartment and treat the child until the liquid is almost all used up. The dose of salbutamol is 2.5 mg (i.e. 0.5 ml of the 5 mg/ml nebulizer solution). This can be given 4-hourly, reducing to 6–8 hourly once the child's condition improves. If necessary in severe cases, it can be given hourly.

2. Salbutamol by metered-dose inhaler with a spacer device

Spacer devices with a volume of 750 ml are commercially available. Introduce two puffs (200 micrograms) into the spacer chamber. Then place the child's mouth over the opening in the spacer and allow normal breathing for 3–5 breaths. This can be repeated in rapid succession until six puffs of the drug have been given to a child < 5 years, 12 puffs for > 5 years of age.

After 6 or 12 puffs, depending on age, assess the response and repeat regularly until the child's condition improves. In severe cases, 6 or 12 puffs can begiven several times an hour for a short period.This can be reduced to 6–8 hourly after the child's condition improves.

Some infants and young children cooperate better when a face mask is attached to the spacer instead of the mouthpiece.

If commercial devices are not available, a spacer device can be made from a plastic cup or a 1-litre plastic bottle. These require 3–4 puffs of salbutamol and the child should breathe from the device for up to 30 seconds.

Subcutaneous epinephrine (adrenaline)

If the above two methods of delivering salbutamol are not available, give a subcutaneous injection of epinephrine (adrenaline) - 0.01 ml/kg of 1:1000 solution (up to a maximum of 0.3 ml), measured accurately with a 1 ml syringe. If there is no improvement after 15 minutes, repeat the dose once.



Figure 4.2: Use of spacer device and face mask to give bronchodilator treatment. A spacer can be made locally from a plastic soft-drink bottle.

Steroids

If a child has a severe or life-threatening acute attack of wheezing (asthma), give oral prednisolone, 1 mg/kg, for 3–5 days (maximum, 60 mg) or 20 mg for children aged 2–5 years. If the child remains very sick, continue the treatment until improvement is seen.

Repeat the dose of prednisolone for children who vomit, and consider IV steroids if the child is unable to retain orally ingested medication. Treatment for up to 3 days is usually suffi cient, but the duration should be tailored to bring about recovery. Tapering of short courses (7–14 days) of steroids is not necessary.

IV hydrocortisone (4 mg/kg repeated every 4 h) provides no benefit and should be considered only for children who are unable to retain oral medication.

Magnesium sulfate

Intravenous magnesium sulfate may provide additional benefit in children with severe asthma treated with bronchodilators and corticosteroids. Magnesium sulfate has a better safety profile in the management of acute severe asthma than aminophylline. As it is more widely available, it can be used in children who are not responsive to the medications described above.

- Give 50% magnesium sulfate as a bolus of 0.1 ml/kg (50 mg/kg) IV over 20 minutes.

Oral bronchodilators

- Once the child has improved sufficiently to be discharged home, if there is no inhaled salbutamol available or affordable, then oral salbutamol (in syrup or tablets) can be given. The dose is: 0.075-0.1 mg/kg 3-4 times a day.

Aminophylline

Aminophylline is not recommended in children with mild-to-moderate acute asthma. It is reserved for children who do not improve after several doses of a rapid-acting bronchodilator given at short intervals plus oral prednisolone.

If indicated in these circumstances:

- Admit the child ideally to a high-care or intensive-care unit, if available, for continuous monitoring.
- Weigh the child carefully and then give IV aminophylline at an initial loading dose of 5–6 mg/kg (up to a maximum of 300 mg) over at least 20 min but preferably over 1 h, followed by a maintenance dose of 5 mg/kg every 6 h.

IV aminophylline can be dangerous at an overdose or when given too rapidly.Omit the initial dose if the child has already received any form of aminophylline or caffeine in the previous 24 h.Stop giving it immediately if the child starts to vomit, has a pulse rate >180/min, develops a headache, or has a convulsion.

Oral bronchodilators

Use of oral salbutamol (in syrup or tablets) is not recommended in the treatment of severe or persistent wheeze. It should be used only when inhaled salbutamol is not available for a child who has improved suffi ciently to be discharged home.

Dosage:

- Age 1 month to 2 years: 100 µg/kg (maximum, 2 mg) up to four times daily
- Age 2–6 years: 1–2 mg up to four times daily

Antibiotics

Antibiotics should not be given routinely for asthma or to a child with asthma who has fast breathing without fever. Antimicrobial treatment is indicated, however, when there is persistent fever and other signs of pneumonia.

Supportive care

Ensure that the child receives daily maintenance fluids appropriate for his/her age. Encourage breastfeeding and oral fluids. Encourage adequate complementary feeding for the young child, as soon as food can be taken.

Monitoring

A hospitalized child should be assessed by a nurse every 3 hours, or every 6

hours as the child shows improvement (i.e. decreased breathing rate, less lower chest wall indrawing, and less respiratory distress), and by a doctor at least once a day.

Record the respiratory rate and watch especially for signs of respiratory failure—increasing hypoxia and respiratory distress leading to exhaustion. If the response to treatment is poor, give salbutamol more frequently, up to once every 60 minutes. If this is ineffective, monitor oxygen therapy as described on Section 10.7.

Complications

If the child fails to respond to the above therapy, or the child's condition worsens suddenly, obtain a chest X-ray to look for evidence of complications like pneumothorax.

Follow-up care

Asthma is a chronic and recurrent condition.

- Once the child has improved sufficiently to be discharged home, inhaled salbutamol through a metered dose inhaler should be prescribed with a suitable (not necessarily commercial) spacer and the mother instructed on how to use it.
- A long-term treatment plan should be made based on the frequency and severity of symptoms. This may include intermittent or regular treatment with bronchodilators, and intermittent courses of steroids. See standard paediatric textbooks for more information.

4.5.3 Wheeze with cough or cold

Most first episodes of wheezing in children aged <2 years are associated with cough and cold. These children are not likely to have a family history of atopy (e.g. hay fever, eczema, and allergic rhinitis) and their wheezing episodes become less frequent as they grow older. The wheezing, if troublesome, might respond to salbutamol treatment at home.

4.6 Conditions presenting with stridor

Stridor is a harsh noise during inspiration, which is due to narrowing of the air passage in the oropharynx, subglottis or trachea. If the obstruction is severe, stridor may also occur during expiration.

The major causes of severe stridor are viral croup (caused by parainfluenza virus, RST measles etc), foreign body, retropharyngeal abscess, diphtheria congenital abnormalities or trauma to the larynx

Diagnosis

History

Depends on the cause of stridor

- first episode or recurrent episode of stridor
- history of choking
- stridor present soon after birth
- fever
- symptoms of common cold (runny nose, sneezing)

Examination

- audible stridor
- hoarseness of the voice
- barking type of cough
- Other findings specific to the cause (bull neck appearance and grey pharyngeal membrane in diphtheria, maculopapular skin rashes in measles etc).
- decreased or absent air entry, cyanosis, signs of respiratory distress in severe cases

Table 4.5 Differential diagnosis of the child presenting with stridor

Diagnosis	In favour
Viral croup	Barking cough Respiratory distress Hoarse voice If due to measles, signs of measles (see section 6.4)
Retropharyngeal abscess	Soft tissue swelling Difficulty in swallowing Fever
Foreign body	Sudden history of choking Respiratory distress
Diphtheria	Bull neck appearance due to enlarged cervical nodes and oedema Red throat Grey pharyngeal membrane Blood-stained nasal discharge No evidence of DTP vaccination
Congenital anomaly	Stridor present since birth laryngotracheomalacia
Epiglottitis	Soft stridor 'Septic' child Little or no cough Drooling of saliva Inability to drink
Anaphylaxis	History of allergen exposure Wheeze Shock Urticaria and oedema of lips and face
Burns	Swollen lips Smoke inhalation

4.6.1 Viral croup

Croup causes obstruction in the upper airway which, when severe, can be life-threatening. Most severe episodes occur in infants. This section deals with croup caused by various respiratory viruses. For croup associated with measles, see chapter 6.

Diagnosis

***Mild croup is characterized by*:**

- fever
- a hoarse voice
- a barking or hacking cough
- stridor that is heard only when the child is agitated

***Severe croup is characterized by*:**

- stridor when the child is quiet
- rapid breathing and indrawing of the lower chest wall
- decreased or absent air entry on auscultation
- cyanosis

Table 4.6 Croup Scoring

	0	**1**	**2**	**3**
Stridor	None	Mild	Moderate at rest	Severe on Inspiration and Expiration None or markedly Reduced air entry
Retraction	None	Mild	Moderate	Severe and marked use of accessory muscles
Air Entry	Normal	Mildly decreased	Moderately decreased	Markedly decreased
Color	Normal	Normal	Normal	Cyanosed
Level of Consciousness	Normal	Restless When disturbed	Anxious Agitated Restless	Lethargic Depressed

Score:

1. Scores 1-5 = mild 2. Scores 6-7 = mild to moderate 3. Scores 7-8 = moderate mostly admitted 4. 8 and above or any of the severe category needs admission for tracheostomy

Treatment

Mild croup can be managed at home with supportive care, including encouraging oral fluids, breastfeeding or feeding, inhalation of steam at home as appropriate

A child with moderate and severe croup should be admitted to hospital for treatment

Non drug therapy

- **Mist therapy**: giving humidified air using croup tent for moderate croup. Oxygen should be given, if there is incipient airway obstruction and a tracheotomy is deemed necessary and is to be performed (Note that the use of nasal prongs or a nasal or nasopharyngeal catheter can upset the child and precipitate obstruction of the airway).
- **Steroid treatment:** Give one dose of dexamethasone (0.6 mg/kg IM), or equivalent dose of some other steroid like prednisolone. If available, use nebulized budesonide at 2 mg. Start the steroids as soon as possible. It is preferable to dissolve the tablet in a spoonful of water for children unable to swallow tablets. Repeat the dose of steroid for children who vomit.
- **Antibiotics:** These are not effective and should not be given.
- **Adrenaline.** As a trial, give the child nebulized adrenaline (2 ml of 1:1000 solution). If this is effective, repeat as often as every hour, with careful monitoring. While this treatment can lead to improvement within 30 min in some children, it is often temporary and may last only about 2 hours.
- Intubation and tracheotomy
- If there are signs of incipient airway obstruction, such as severe indrawing of the lower chest wall and restlessness, intubate the child immediately.
- If this is not possible, transfer the child urgently to a hospital where intubation or emergency tracheotomy can be done.
- If this is not possible, monitor the child closely and ensure that facilities for an emergency tracheotomy are immediately available, as airway obstruction can occur suddenly.

Tracheotomy should only be done by experienced staff or a pediatric

surgeon.

Supportive care

- Don't disturb the child
- If the child has fever (≥ 39 ° C or ≥ 102.2 ° F) which appears to be causing distress, give paracetamol.
- Encourage breastfeeding and oral fluids.
- Children on croup tent should be on iv fluid till they are out of it
- Encourage the child to eat as soon as food can be taken.

Monitoring - The child's condition, especially respiratory status, should be assessed by nurses every 3 hours and by doctors twice a day. The child should occupy a bed close to the nursing station, so that any sign of incipient airway obstruction can be detected as soon as it develops.

4.6.2 Diphtheria

Diphtheria is a bacterial infection caused by Corynebacterium diphtheria and it can be prevented by immunization. Infection in the upper airway or nasopharynx produces a grey membrane which, when present in the larynx or trachea, can cause stridor and obstruction. Nasal involvement produces a bloody discharge. Diphtheria toxin causes muscular paralysis and myocarditis, which is associated with increased mortality.

Diagnosis

Carefully examine the child's nose and throat and look for a grey, adherent membrane, which cannot be wiped off with a swab. Great care is needed when examining the throat, as this may precipitate complete obstruction of the airway. A child with pharyngeal diphtheria may have an obviously swollen neck, termed a 'bull neck'.



Figure 4.3: Pharyngeal membrane of diphtheria; Note: the membrane extends beyond the tonsils and covers the adjacent pharyngeal wall.



Figure 4.4: Bull neck: a sign of diphtheria due to enlarged lymph nodes in the neck

Treatment

Antitoxin

- Give 40 000 units of diphtheria antitoxin (IM or IV) immediately, because delay can lead to increased mortality.
- As there is a small risk of a serious allergic reaction to the horse serum in the antitoxin, an initial intradermal test to detect hypersensitivity should be carried out, as described in the instructions and treatment for anaphylaxis be made available.

Antibiotics

Any child with suspected diphtheria should be given procaine penicillin (50, 000 units/kg IM) daily for 7 days.

Oxygen

- Avoid using oxygen unless there is incipient airway obstruction. Signs such as severe indrawing of the lower chest wall and restlessness are more likely to indicate the need for tracheostomy (or intubation) than oxygen. Moreover, the use of nasal prongs or a nasal or nasopharyngeal catheter can upset the child and precipitate obstruction of the airway.
- However, oxygen should be given, if there is incipient airway obstruction and a tracheotomy is deemed necessary and is to be performed.

Tracheotomy/intubation

- Tracheotomy should be performed only by experienced staff or surgeon, if there are signs of incipient airway obstruction, such as severe lower chest wall indrawing and restlessness. If obstruction occurs, an emergency tracheostomy should be carried out. Orotracheal intubation is an alternative, but may dislodge the membrane and fail to relieve the obstruction.

Supportive care

- If the child has fever (≥ 39°C or ≥ 102.2°F) which appears to be causing distress, give paracetamol.
- Encourage the child to eat and drink. If there is difficulty in swallowing, nasogastric feeding is required.
- Avoid frequent examinations or disturbing the child unnecessarily.

Monitoring

The child's condition, especially respiratory status, should be assessed by nurses every 3 hours and by doctors twice a day. The child should occupy a bed close to the nursing station, so that any sign of incipient airway obstruction can be detected as soon as it develops.

Complications

Myocarditis and paralysis may occur 2–7 weeks after the onset of illness. Signs of myocarditis include a weak, irregular pulse and evidence of heart failure. Refer to standard paediatric textbooks for details of the diagnosis and management of myocarditis.

Public health measures

- Nurse the child in a separate room by staffs that are fully immunized against diphtheria.
- Give all immunized household contacts a diphtheria toxoid booster.
- Give all unimmunized household contacts one IM dose of benzathine penicillin (600,000 units to those aged ≤ 5 years; 1,200,000 units to those aged >5 years). Immunize them with

diphtheria toxoid and check daily for 5 days for any signs of diphtheria.

4.6.3 Epiglottitis

Epiglottitis is a medical emergency that may result in death if not treated quickly. It is mainly caused by the bacteria H. infl uenzae type b but may also be caused by other bacteria or viruses associated with upper respiratory infections.

Epiglottitis usually begins as an infl ammation and swelling between the base of the tongue and the epiglottis. The swelling may obstruct the airway.

Diagnosis

- sore throat with diffi culty in speaking
- diffi culty in breathing
- soft stridor
- fever
- drooling of saliva
- difficulty in swallowing or inability to drink.

Treatment

Treatment of patients with epiglottitis is directed to relieving the airway obstruction and eradicating the infectious agent.

- Keep the child calm, and provide humidified oxygen, with close monitoring.
- Avoid examining the throat if the signs are typical, to avoid precipitating
  obstruction.
- Call for help and secure the airway as an emergency because of the danger
  of sudden, unpredictable airway obstruction. Elective intubation is the best treatment if there is severe obstruction but may be very difficult; consider the need for surgical intervention to ensure airway patency.
- Give IV antibiotics when the airway is safe: ceftriaxone at 80 mg/kg once daily for 5 days.

4.6.4 Anaphylaxis

Anaphylaxis is a severe allergic reaction, which may cause upper airway obstruction with stridor, lower airway obstruction with wheezing or shock or all three. Common causes include allergic reactions to antibiotics, to vaccines, to blood transfusion and to certain foods, especially nuts.

Consider the diagnosis if any of the following symptoms is present and there is a history of previous severe reaction, rapid progression or a history of asthma, eczema or atopy.

This situation is potentially life-threatening and may result in a change in level of consciousness, collapse, or respiratory or cardiac arrest.

- Assess the airways, breathing and circulation.
- If the child is not breathing, give five rescue breaths with a bag-valve mask and 100% oxygen and assess circulation.
- If no pulse, start basic life support

Table 4.7 classification of the severity of anaphylaxis

Severity	Symptoms	Signs
Mild	– Itching mouth – Nausea	– Urticaria – Oedema of the face – Conjunctivitis – Red throat
Moderate	– Cough or wheeze – Diarrhoea – Sweating	– Wheeze – Tachycardia – Pallor
Severe	– Difficulty in breathing – Collapse – Vomiting	– Severe wheeze with poor air entry – Oedema of the larynx – Shock – Respiratory arrest – Cardiac arrest

Treatment

- Remove the allergen as appropriate.
- For mild cases (just rash and itching), give oral antihistamine and oral prednisolone at 1 mg/kg.
- For moderate cases with stridor and obstruction or wheeze:
  - Give adrenaline at 0.15 ml of 1:1000 IM into the thigh (or subcutaneous); the dose may be repeated every 5–15

min.

- For severe anaphylactic shock:
  - Give adrenaline at 0.15 ml of 1:1000 IM and repeat every 5–15 min.
  - Give 100% oxygen.
- Ensure stabilization of the airway, breathing, circulation and secure IV access.
- If the obstruction is severe, consider intubation or call a anaesthetist and surgeon to intubate or create a surgical airway.
- Administer 20 ml/kg normal saline 0.9% or Ringer's lactate solution IV asrapidlyas possible. If IV access is not possible, insert an intraosseous line.

4.7 Conditions presenting with chronic cough

Chronic cough is one that lasts for more than 2 weeks.

History

Ask for

- duration of coughing
- nocturnal cough
- paroxysmal cough or associated severe bouts ending with vomiting or whooping
- weight loss (check growth chart, if available), night sweats
- persistent fever
- close contact with a known case of Tb patients or with pertussis
- history of attacks of wheeze and a family history of allergy or asthma
- history of choking or inhalation of a foreign body
- child suspected or known to be HIV-infected
- treatment given and response

Examination

- fever
- lymphadenopathy (generalized and localized, e.g. in the neck)
- wasting
- wheeze / prolonged expiration

- apnoeic episodes
- subconjunctival haemorrhages
- signs associated with foreign body aspiration:
  - unilateral wheeze
  - area of decreased breath sounds which is either dull or hyper-resonant on percussion
  - deviation of the trachea or apex beat.
- signs associated with HIV infection.
- clubbing , cyanosis
- cardiac findings (murmur)

Table 4.8 Differential diagnosis of the child presenting with chronic cough

Diagnosis	In favour
Tuberculosis	Weight loss or failure to thrive Anorexia, night sweats Enlarged liver and spleen Chronic or intermittent fever History of contact with chronic cougher Signs of fluid in chest (dull to percussion/reduced breath sounds)
Asthma	History of recurrent wheeze, often unrelated to coughs and colds History of asthma/atopy in the family Hyperinflation of the chest Prolonged expiration Reduced air entry (in very severe airway obstruction) Good response to bronchodilators
Foreign body	Sudden onset of choking or stridor ,wheezing or hyperinflation Unilateral chest signs Recurrent lobar consolidation Poor response to medical treatment
Pertussis	Paroxysms of cough followed by whoop, vomiting, cyanosis or apnoea Subconjunctival haemorrhages No history of DPT immunization Afebrile

HIV	Known or suspected maternal or sibling HIV infection History of blood transfusion Failure to thrive Oral thrush Chronic parotitis Skin infection with herpes zoster (past or present) Generalized lymphadenopathy Chronic fever Persistent diarrhoea
Bronchiectasis	Finger clubbing History of tuberculosis or aspirated foreign body Poor weight gain Purulent sputum, bad breath Finger clubbing Localized signs on X-ray
Lung abscess	Reduced breath sounds over abscess Poor weight gain / chronically ill child Cystic or cavitating lesion on chest X-ray

4.7.1 Pertussis

Caused by a bacteria Bordetella pertussis .It is most severe in young infants who have not yet been immunized. After an incubation period of 7–10 days, the child develops fever, usually with a cough and nasal discharge which clinically are indistinguishable from a common cold and cough. In the second week, there is paroxysmal coughing which can be recognized as pertussis. The episodes of coughing can continue for 3 months or longer. The child is infectious for a period of 2 weeks up to 3 months after the onset of illness.

Diagnosis

Suspect pertussis if a child has been having a severe cough for more than two weeks, especially if the disease is known to be occurring locally. The most useful diagnostic signs are:

- Paroxysmal coughing followed by a whoop when breathing in, often with vomiting
- Subconjunctival haemorrhages
- Child not immunized against pertussis.

- Young infants may not whoop; instead, the cough may be followed by cessation of breathing (apnoea) or cyanosis, or apnoea may occur without coughing.
- Also, examine the child for signs of pneumonia and ask about convulsions.



Figure 4.5: Subconjunctival haemorrhages prominent on the white sclera

Treatment

Treat mild cases in children aged ≥ 6 months at home with supportive care. Admit infants aged under 6 months to hospital; also admit any child with pneumonia, convulsions, dehydration, severe malnutrition, or prolonged apnoea or cyanosis after coughing.

Antibiotics

- Give oral erythromycin (12.5 mg/kg four times a day) for 10 days. This does not shorten the illness but reduces the period of infectiousness.
- Alternatively, if available, give azithromycin at 10 mg/kg (maximum, 500 mg) on the first day, then 5 mg/kg (maximum, 250 mg) once a day for 4 days.
- If there is fever, if erythromycin or azithromycin is not available, or if there are signs of pneumonia, treat with amoxicillin as possible secondary pneumonia.
- Follow the other guidelines for severe pneumonia

Oxygen

- Give oxygen to children who have spells of apnoea or cyanosis, or severe paroxysms of coughing or low oxygen saturation ≤ 90% on a pulse oxymeter
- Use nasal prongs, not a nasopharyngeal catheter or nasal catheter which can provoke coughing. Place the prongs just inside the nostrils and secure with a piece of tape just above the upper lip. Care should be taken to keep the nostrils clear of mucus since this blocks the flow of oxygen. Set a flow rate of 1–2 litres/min (0.5 litre/min in young infants). Humidification is not required with nasal prongs.
- Continue oxygen therapy until the above signs are no longer present, after which there is no value in continuing with oxygen.
- The nurse should check, every 3 hours, that the prongs or catheter are in the correct place and not blocked with mucus, and that all connections are secure.

Airway management

- During paroxysms of coughing, place the child head down and prone, or on the side, to prevent any inhaling of vomitus and to aid expectoration of secretions.
- If the child has cyanotic episodes, clear secretions from the nose and throat with brief, gentle suction.
- If apnoea occurs, clear the airway immediately with gentle suction, give manual respiratory stimulation or bag ventilation, and administer oxygen.

Supportive care

- Avoid, as far as possible, any procedure that could trigger coughing, such as application of suction, throat examination, and use of a nasogastric tube.
- Do not give cough suppressants, sedatives, mucolytic agents or anti histamines.
- If the child has fever (≥ 39 ° C) which appears to be causing

distress, give paracetamol.

- Encourage breastfeeding or oral fluids. If the child cannot drink, pass a nasogastric tube and give small, frequent amounts of fluid to meet the child's maintenance needs (see chapter 10). If there is respiratory distress, give maintenance fluids IV to avoid the risk of aspiration and reduce triggering of coughing. Ensure adequate nutrition by giving smaller, more frequent feeds. If there is continued weight loss despite these measures, feed the child by nasogastric tube.

Monitoring

The child should be assessed by nurses every 3 hours and by the doctor once a day. To facilitate observation for early detection and treatment of apnoeic or cyanotic spells, or severe episodes of coughing, the child should occupy a bed in a place close to the nursing station where oxygen is available. Also, teach the child's mother to recognize apnoeic spells and to alert the nurse if these occur.

Complications

Pneumonia: is the most common complication of pertussis caused by secondary bacterial infection or inhalation of vomited material.

- Signs suggesting pneumonia include fast breathing between coughing episodes, fever, and the rapid onset of respiratory distress.
- Treat pneumonia in children with pertussis as follows:
    - Give parenteral ampicillin (or benzylpenicillin) for 5 days,or alternatively give azithromycin for 5 days.
    - Give oxygen as described for the treatment of severe pneumonia

  Convulsions: These may result from anoxia associated with an apnoeic or cyanotic episode, or toxin-mediated encephalopathy.
- If a convulsion does not stop within two minutes, give an anticonvulsant (diazepam or paraldehyde)

Malnutrition: Children with pertussis may become malnourished as a result of reduced food intake and frequent vomiting.

- Prevent malnutrition by ensuring adequate feeding, as described above, under "supportive care".

Haemorrhage and hernias: Subconjunctival haemorrhage and epistaxis are common during pertussis.

- No specific treatment is needed.
- Umbilical or inguinal hernias may be caused by violent coughing.
- Do not treat them unless there are signs of bowel obstruction, but refer the child for surgical evaluation after the acute phase.

Public health measures

- Give DPT immunization to any child in the family who is not fully immunized and to the child with pertussis.
- Give a DPT booster to previously immunized children.
- Give erythromycin estolate orally (12.5 mg/kg 4 times a day) for 14 days should be given promptly to all household and other close contacts such as day care regardless of age, history of immunization or symptoms.

4.7.2 Tuberculosis

Most children infected with Mycobacterium tuberculosis do not develop tuberculosis disease. The only evidence of infection may be a positive skin test. The development of tuberculosis disease depends on the competence of the immune system to resist multiplication of the M. tuberculosis infection. This competence varies with age, being least in the very young. HIV and severe malnutrition lower the body's defences, and measles and whooping cough temporarily impair the strength of the immune system. In the presence of any of these conditions, tuberculosis disease can develop more easily. Any organ including cervical lymph nodes, bones, joints, abdomen, ear, eye, and skin may be affected by M.tuberculosis.

But it is most often severe when the disease is located in the lungs, meninges or kidney. Many children present only with failure to grow

normally, weight loss or prolonged fever. Chronic cough can also be a presenting sign; in children, however, sputum-positive pulmonary tuberculosis is rarely diagnosed.

Diagnosis

The risk of tuberculosis is increased when there is an active case (infectious, smear-positive pulmonary tuberculosis) in the same house, or when the child is malnourished, has HIV/AIDS, or has had measles in the past few months. Consider tuberculosis in any child with the following:

History:

- unexplained weight loss or failure to grow normally;
- unexplained fever, especially when it continues for more than 2 weeks;
- chronic cough (i.e. cough for more than 3 weeks)
- exposure to an adult with probable or definite pulmonary tuberculosis.

Examination:

- enlarged non-tender lymph nodes or a lymph node abscess, especially in the neck
- crackles, bronchial breath sound , etc
- signs of fluid in the chest
- signs of meningitis, especially when these develop over several days and the spinal fluid contains mostly lymphocytes and elevated protein;
- abdominal swelling, with or without palpable lumps; ascites
- progressive swelling or deformity in the bone or a joint, including the spine.

Investigations

- Try to obtain specimens for microscopic examination of acid-fast bacilli (Ziehl-Neelsen stain) and for culture of tubercle bacilli. Possible specimens include three consecutive early morning fasting gastric aspirates, sputum, CSF (if clinically indicated), and

pleural fluid and ascites fluid. Owing to low detection rates by these methods, a positive result would confirm tuberculosis, but a negative result does not exclude the disease.

- Obtain a chest X-ray. A diagnosis of tuberculosis is supported when a chest X-ray shows a miliary pattern of infiltrates or a persistent area of infiltrate or consolidation, often with pleural effusion, or a primary complex.
- Perform a PPD skin test: The test is usually positive in children with tuberculosis (reactions of >10 mm are suggestive of tuberculosis; <10 mm in a child, previously immunized with BCG, is equivocal). However, the PPD test may be negative in children with tuberculosis who have HIV/AIDS or when there is miliary disease, severe malnutrition or recent measles.
- Xpert MTB/RIF should be used as the initial diagnostic test in children suspected of having multidrug-resistant TB (MDR-TB) or HIV-associated TB.
- Routine HIV testing should be offered to all children suspected of TB.

Treatment

The lesions of primary tuberculosis have a smaller number of M. tuberculosis organisms than those of secondary (reactivated) pulmonary tuberculosis. Thus, treatment failure, relapse, and development of secondary resistance are less common among children. Children with pulmonary TB usually have low bacterial load, as cavitating disease is relatively rare. On the other hand, children more often develop extra-pulmonary TB (EPTB). Very severe and disseminated TB (e.g. miliary TB and TB meningitis) is commonly found in the young (<3 years old) child. Because tuberculosis in infants and children younger than 4 years of age is more likely to disseminate, treatment should be started as soon as the diagnosis is made.

Children and adolescents with adult-type pulmonary tuberculosis should be treated with the initiation of four-drug regimen. Three times a week therapy is not recommended for children. Pyridoxine is recommended for infants, children, and adolescents who are being treated with INH and who have nutritional deficiencies, symptomatic HIV infection, or who are breastfeeding. DOT should be used for all children with tuberculosis. Even when drugs are given under DOT, tolerance of the medications must be monitored closely. DOTS treatment must be directly supervised by health professionals. In general, extra-pulmonary tuberculosis in children can be treated with the same regimens as pulmonary disease. Exceptions are disseminated TB disease, and meningitis, for which the recommended duration is 9 to 12 months.

Table 4.9 Anti-TB regimens for children

A. FDC dosing regimens for NEW CASES

Weight (kg)	Intensive phase (2 months)			Continuation phase (4 months)		
	RHZ (60,30,150)	RHZE (150,75,400,275)	E (100)	RH (150,75)	RH (60,30)	RH (60,60)
5 to 7	1		1		1	1
8 to 14	2		2		2	1
15 to 20	3		3		3	2
21 to 30*		2		2		2

B. FDC dosing regimens for Retreatment Cases

Weight (kg)	Intensive phase (3Months)			Continuation phase (5Months)				
	RHZ (60,30,150)	RHZE (150,75,400,275)	E (100)	RH (60,30)	RH (150,75)	RH (60,60)	E (100)	E (400)
5 to 7	1		1	1		1	1	
8 to 14	2		2	2		1	2	
15 to 20	3		3	3		2	3	
21 to 30*		2			2	2		1

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(FMOHE, GUIDELINES FOR CLINICAL AND PROGRAMMATIC MANAGEMENT OF TB, LEPROSY AND TB/HIV IN ETHIOPIA, APRIL, 2012)

NOTE: *1. Children with suspected or confirmed Tuberculous meningitis, genitor-urinary and osteo-articular TB should be treated with a four-drug regimen (HRZE) for 2 months, followed by a two-drug*

regimen (HR) for 10 months; the total duration of treatment being 12 months. The recommended treatment dosages are the same as those described for pulmonary tuberculosis.

2. *All Anti-TB drugs should be administered daily and intermittent therapy is not recommended.*

Table 4.9.1 Recommended doses of paediatric treatment:

Drug	Recommended dose			
	Daily			
	Dose and range mg/Kg body weight)	Maximum (mg)		
Isoniazid	10 (10-15)	300		
Rifampicin	15 (15-20)	600		
Pyrazinamide	25 (20- 30)	-		
Ethambutol	20 (20- 30)	-		

(FMOHE, Tuberculosis, Leprosy and Tb/HIV prevention and Control Program, Manual 4th edition, 2008)

The recommended dose of Ethambutol is higher in children (20 mg/Kg) than in adults (15 mg/Kg), because the pharmacokinetics is different. Although ethambutol was frequently omitted from treatment regimens for children in the past, due in part to concerns about the difficulty of monitoring for toxicity (particularly for optic neuritis) in young children, a literature review indicates that it is safe in children at a dose of 20 mg/Kg [range 15-25 mg/Kg/daily].

Streptomycin should be avoided when possible in children because the injections are painful and irreversible auditory nerve damage may occur.

Multidrug-resistant TB

In cases of MDR TB, treat children with proven or suspected pulmonary TB or tuberculous meningitis with a fl uoroquinolone or other second-line TB drug. An appropriate MDR TB treatment regimen in the context of a wellfunctioning MDR TB control programme should be used. The decision to treat should be taken by a clinician experienced in managing paediatric TB. For detailed information refer the national MDR TB guideline.

Monitoring

Confirm that the medication is being taken as instructed, by direct observation of each dose. Monitor the child's weight gain (daily) and temperature (twice daily) in order to check for resolution of the fever. These are signs of the response to therapy. When treatment is given for suspected tuberculosis, improvement should be seen within one month. If this does not happen, review the patient, check compliance and reconsider the diagnosis.

Public health measures

- Notify the case to the responsible district health authorities. Ensure that treatment monitoring is carried out, as recommended by the national tuberculosis programme. Check all household members of the child (and, if necessary, school contacts) for undetected cases of tuberculosis and arrange treatment for any who are found.
- Children < 5 years of age who are household or close contacts of people with TB and who, after an appropriate clinical evaluation, are found not to have active TB should be given 6 months of isoniazid preventive therapy (10 mg/ kg/day, range 7–15 mg/kg, maximum dose 300 mg/day).

Follow-up

A programme of 'active' follow-up, in which a health worker visits the child and his or her family at home, can reduce default from TB treatment. During follow-up at home or in hospital, health workers can:

- Check whether medications for TB are being taken regularly.

Remind the family and the treatment supporter about the importance of taking medications regularly, even if the child is well, for the full duration of treatment.

- Screen family contacts, including other children in the family, by inquiring about cough, and start these children on isoniazid preventive therapy.
- Suggest how the family's home environment might be made healthier for children, such as eliminating smoking inside the house, good ventilation and hand-washing.
- Discuss with the parents the importance of nutrition in recovery from TB and any problems in providing good nutrition for their children.
- Check the child for growth, nutritional state and signs of TB and other treatable conditions. If problems are found, the health worker should recommend how these can be treated or refer the family to a paediatrician.
- Check the child's health record, and tell the parents when and where they should bring the child for doses of vaccine.
- Ask the parents if they have any questions or concerns, and answer or discuss these, or refer the family to a paediatrician.
- Record their observations on the TB treatment card.

4.7.3 Foreign body aspiration

Nuts, seeds or other small objects may be inhaled, most often by children under 4 years of age. The foreign body usually lodges in a bronchus (more often in the right) and can cause collapse or consolidation of the portion of lung distal to the site of blockage. Choking is a frequent initial symptom. This may be followed by a symptom-free interval of days or weeks before the child presents with persistent wheeze, chronic cough or pneumonia, which fails to respond to treatment. Small sharp objects can lodge in the larynx causing stridor or wheeze. Rarely, a large object lodging in the larynx could cause sudden death from asphyxia, unless an emergency

tracheostomy is done.

Diagnosis

Inhalation of a foreign body should be considered in a child with the following signs:

- sudden onset of choking, coughing or wheezing; or
- segmental or lobar pneumonia which fails to respond to antibiotic therapy (note also differential diagnosis of tuberculosis.

Examine the child for:

- unilateral wheeze;
- an area of decreased breath sounds which is either dull or hyper-resonant on percussion;
- deviation of the trachea or apex beat.

Obtain a chest X-ray at full expiration to detect an area of hyper-inflation or collapse, mediastinal shift (away from the affected side), or a foreign body if it is radio-opaque.

Treatment

Emergency first aid for the choking child is mandatory. Attempt to dislodge and expel the foreign body. The maneuver depends on the age of the child.

For infants:

- Lay the infant on one arm or on the thigh in a head-down position.
- Strike the infant's back five times with the heel of the hand.
- If the obstruction persists, turn the infant over and give five chest thrusts with two fingers, one finger's breadth below the nipple level in the midline.
- If the obstruction persists, check the infant's mouth for any obstruction which can be removed.
- If necessary, repeat this sequence with back slaps again.

For older children:

- While the child is sitting, kneeling or lying, strike the child's back five

times with the heel of the hand.

- If the obstruction persists, go behind the child and pass your arms around the child's body; form a fist with one hand immediately below the sternum; place the other hand over the fist and thrust sharply upwards into the abdomen. Repeat this up to five times.
- If the obstruction persists, check the child's mouth for any obstruction which can be removed.
- If necessary, repeat the sequence with back slaps again.
- Once this has been done, it is important to check the patency of the airway by:
  - looking for chest movements
  - listening for breath sounds, and
  - feeling for breath.

If further management of the airway is required after the obstruction is removed see chapter 4. This describes actions which will keep the child's airway open and prevent the tongue from falling back to obstruct the pharynx while the child recovers.

- If not sure of foreign body or suspected refer the child to a hospital where diagnosis is possible and the object can be 'removed' by bronchoscopy. If there is evidence of pneumonia, begin treatment with ampicillin and gentamicin, as for severe pneumonia.

4.8 Heart failure

Heart failure in infants and young child may be manifested by fast breathing and respiratory distress. Underlying causes include congenital heart disease (usually in the first few months of life), acute rheumatic fever, myocarditis, pericarditis with or without constriction, infective endocarditis, acute glomerulonephritis, severe anaemia, and severe malnutrition. Heart failure can be precipitated or worsened by fluid overload, especially when giving salt-containing IV fluids.

Table 4.10 Normal pulse rate for age

Age	Lower limits of normal	Average	Upper limits of normal
Newborn	70/mn	125/mn	190/mn
1-11 mo	80	120	160
2 yr	80	110	130
4 yr	80	100	120
6 yr	75	100	115
8 yr	70	90	110
10 yr	70	90	110

Nelson Text book of Pediatrics 19th edition

Diagnosis

The most common signs of heart failure, on examination, are:

- Fast breathing or interruption of feeding wit diaphoresis
- Tachycardia (heart rate >160/minute in a child under 12 months old; >120/minute in a child aged 12 months to 5 years).
- Basal crackles on chest exam
- Gallop rhythm on auscultation with or without murmurs.
- Enlarged, tender liver.
- In older children: oedema of the feet, hands or face, or raised JVP
- Severe palmar pallor may be present if severe anaemia is the cause of the heart failure.
- If the diagnosis is in doubt, a chest X-ray can be taken and will show an enlarged heart.
- Measure blood pressure if possible. If raised consider acute glomerulonephritis or coarctation of the aorta (see standard paediatric textbook for treatment)

Treatment

- Oxygen: Give oxygen if the child has a respiratory rate of ≥

70/min, shows signs of respiratory distress, or has central cyanosis. (Section 10.7).

- Diuretics: Give furosemide (frusemide): a dose of 1 mg/kg should cause increased urine flow within 2 hours. For faster action, give the drug IV. If the initial dose is not effective, give 2 mg/kg and repeat in 12 hours, if necessary. Thereafter, a single daily dose of 1–2 mg/kg orally..
- Supplemental potassium: if frusemide is given for more than 5 days, give spironolactone if not available add oral potassium (3–5 mmol/kg/day).
- Digoxin: after evaluation by a cardiologist.

Supportive care

- Avoid the use of IV fluids, where possible.
- Support the child in a semi-seated position with head and shoulders elevated and lower limbs dependent.
- Relieve any fever with paracetamol to reduce the cardiac workload.
- Avoid unnecessary movement and transportation
- Consider transfusion if severe anemia is present

Monitoring

The child should be checked by nurses every hour and by doctors once a day. Monitor daily both respiratory and pulse rates, liver size, and body weight to assess the response to treatment. Continue treatment until the respiratory and pulse rates are normal and the liver is no longer enlarged.

- Consult cardiologist

CHAPTER 5 – DIARRHOEA

This chapter gives treatment guidelines on the management of acute diarrhoea (with severe, some or no dehydration), persistent diarrhoea, and dysentery in children 2 months to 5 years. Assessment and management of diarrhea in severely malnourished children is described in another section. The 3 essential elements in the management of all children with diarrhoea are **rehydration therapy, zinc supplementation and counseling for continued feeding and prevention.**

During diarrhea there is an increased loss of water and electrolytes (sodium, potassium, bicarbonate and zinc) in the liquid stool. Dehydration occurs when these losses are not adequately replaced and a deficit of water and electrolytes develops. The degree of dehydration is graded according to symptoms and signs that reflect the amount of fluid. The rehydration regimen is selected according to the degree of dehydration.

Zinc is an important micronutrient for a child's overall health and development. Zinc is lost in greater quantity during diarrhoea. Replacing the lost zinc is important to help the child recover and to keep the child healthy in the coming months. For these reasons, all patients with diarrhoea should be given zinc supplements as soon as possible after the diarrhoea has started.

During diarrhoea, a decrease in food intake and nutrient absorption and increased nutrient requirements often combine to cause weight loss and failure to grow. In turn, malnutrition can make the diarrhoea more severe, more prolonged and more frequent, compared with diarrhoea in non-malnourished children. This vicious circle can be broken by giving nutrient-rich foods during the diarrhoea and when the child is well.

Antibiotics should not be used routinely. "Anti diarrhoeal" drugs and anti-emetics should not be given to young children with acute or persistent diarrhoea or dysentery; they do not prevent dehydration or improve

nutritional status and some have dangerous, sometimes fatal, side-effects.

5.1 Child presenting with diarrhoea

History

A careful feeding history is essential in the management of a child with diarrhoea. Also, inquire into the following:

- Diarrhea
  - Frequency of stools
  - Duration of diarrhea
  - Presence of blood in stools
- Local reports of cholera outbreak
- Recent antibiotic or other drug treatment
- Attacks of crying with pallor in an infant
- Condition of feeding
- Presence of danger signs
- Last voiding (urine)

Physical Examination

Check for vital signs: also helps for follow up

Look for:

- Signs of dehydration:
  - Restlessness or irritability
  - Lethargy/reduced level of consciousness
  - Sunken eyes
  - Skin pinch returns slowly or very slowly
  - Thirsty/drinks eagerly, or drinking poorly or not able to drink
- Signs of shock
  - Capillary refill

- Mental status
- Blood in stool
- Signs of severe malnutrition
- Abdominal mass
- Abdominal distension

Investigation:

The following investigations directed to diarrhea can be done in hospitals

- Stool examination (microscopy)
- Stool Culture & Sensitivity test
- Investigations directed to complications

There is no need for routine stool microscopy or culture in children except with bloody and persistent diarrhea.

Table 5.1 Differential diagnosis of the child presenting with diarrhea

Diagnosis	In favour
Acute (watery) diarrhea	More than 3 stools per day No blood in stools
Cholera	Diarrhoea with severe dehydration during cholera outbreak Positive stool culture for V. cholerae O1 or O139
Dysentery	Blood in stool (seen or reported)
Persistent diarrhea	Diarrhoea lasting 14 days or longer
Diarrhoea with severe malnutrition	Any diarrhoea with signs of severe malnutrition
Diarrhoea associated with recent antibiotic use	Recent course of broad-spectrum antibiotics
Intussusceptions	Blood in stool Abdominal mass (check with rectal examination) Attacks of crying with pallor in infant

5.2 Acute Diarrhoea

Table 5.2: Classification of the severity of dehydration in children with diarrhea

Classification	Signs or symptoms	Treatment
Severe dehydration	*Two or more of the following signs:* ▪ Lethargy/unconsciousness ▪ Sunken eyes ▪ Unable to drink or drinks poorly ▪ Skin pinch goes back very slowly (≥ 2 seconds)	▪ Give fluid for severe dehydration ▪ (see Diarrhoea Treatment Plan C in in section 5.2.1
Some dehydration	*Two or more of the following signs:*dehydration (see Diarrhoea ▪ Restlessness, irritability ▪ Sunken eyes ▪ Drinks eagerly, thirsty, may not be reliable sign for young infants ▪ Skin pinch goes back slowly	▪ Give fluid and food for some dehydration - Treatment Plan B sec 5.2.2 ▪ After rehydration, advise mother on home treatment and when to return immediately ▪ Follow up in 5 days if not improving
No dehydration	▪ Not enough signs to classify assome or severe dehydration	▪ Give fluid and food to treat diarrhoea at home (see DiarrhoeaTreatment Plan A, Section 5.2.3) ▪ Advise mother on when to return immediately (see Section 5.2.3) ▪ Follow up in 5 days if not improving.

Assessing dehydration

For all children with diarrhoea, hydration status should be assessed and classified as severe dehydration, some dehydration or no dehydration and appropriate treatment given.

5.2.1 Severe Dehydration

Children with severe dehydration require rapid IV rehydration with close monitoring, which is followed by oral rehydration once the child starts to improve sufficiently.

Diagnosis

If any two of the following signs are present in a child with diarrhoea, severe dehydration should be diagnosed:

- Lethargy or unconsciousness
- Sunken eyes
- Skin pinch goes back very slowly (2 seconds or more)
- Not able to drink or drinks poorly.

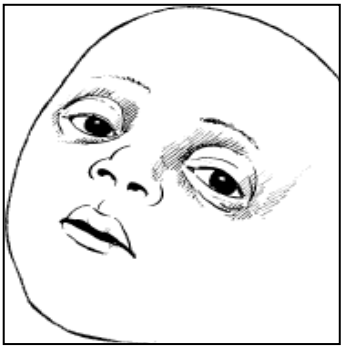


Figure 5.1 Sunken eyes

Treatment

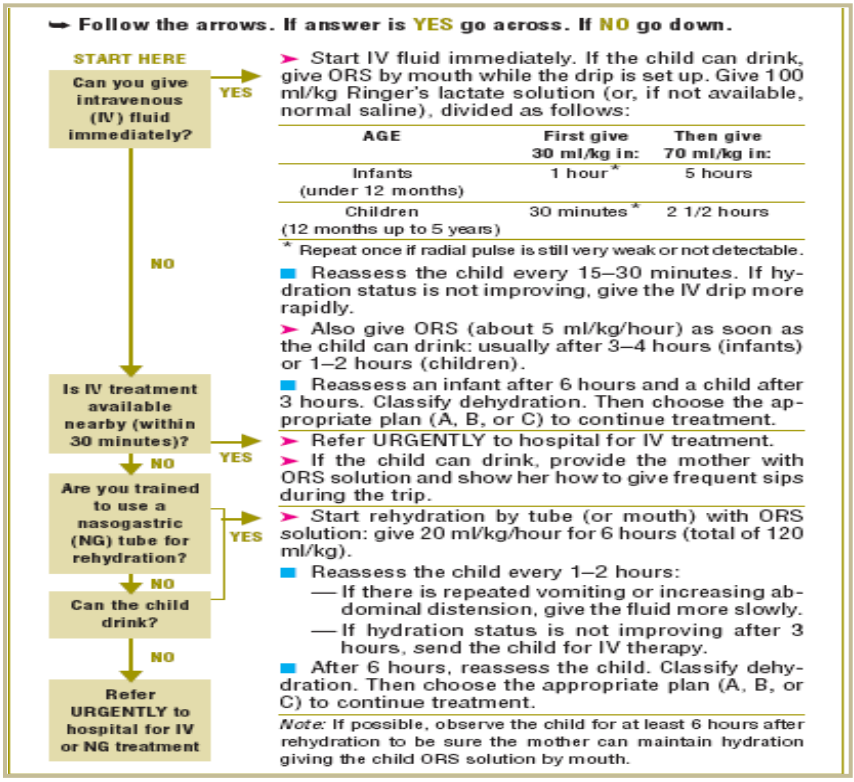
- Start IV fluids immediately. While the drip is being set up, give ORS solution if the child can drink.

Note: *The best IV fluid solutions for rehydration are isotonic solutions:*

Ringer's lactate or normal saline (0.9% NaCl). Do not use 5% glucose (dextrose) solution as they increase the risk for hyponatraemia, which can cause cerebral oedema.

When the full amount of IV fluid has been given, reassess the child's hydration status fully. Persistent severe dehydration after IV rehydration is unusual; it usually occurs only in children who pass large watery stools frequently during the rehydration period. If the child is improving but still shows signs of some dehydration, discontinue IV treatment and give ORS solution for 4 hours.

Chart 5.1 Diarrhea Treatment Plan C: Treat severe dehydration quickly


➥ Follow the arrows. If answer is YES go across. If NO go down.
START HERE
Can you give intravenous (IV) fluid immediately?
YES
NO
Is IV treatment available nearby (within 30 minutes)?
YES
NO
Are you trained to use a nasogastric (NG) tube for rehydration?
YES
NO
Can the child drink?
NO
Refer URGENTLY to hospital for IV or NG treatment
➤ Start IV fluid immediately. If the child can drink, give ORS by mouth while the drip is set up. Give 100 ml/kg Ringer's lactate solution (or, if not available, normal saline), divided as follows:
AGE | First give 30 ml/kg in: | Then give 70 ml/kg in:
Infants (under 12 months) | 1 hour* | 5 hours
Children (12 months up to 5 years) | 30 minutes* | 2 1/2 hours
* Repeat once if radial pulse is still very weak or not detectable.
■ Reassess the child every 15–30 minutes. If hydration status is not improving, give the IV drip more rapidly.
➤ Also give ORS (about 5 ml/kg/hour) as soon as the child can drink: usually after 3–4 hours (infants) or 1–2 hours (children).
■ Reassess an infant after 6 hours and a child after 3 hours. Classify dehydration. Then choose the appropriate plan (A, B, or C) to continue treatment.
➤ Refer URGENTLY to hospital for IV treatment.
➤ If the child can drink, provide the mother with ORS solution and show her how to give frequent sips during the trip.
➤ Start rehydration by tube (or mouth) with ORS solution: give 20 ml/kg/hour for 6 hours (total of 120 ml/kg).
■ Reassess the child every 1–2 hours:
— If there is repeated vomiting or increasing abdominal distension, give the fluid more slowly.
— If hydration status is not improving after 3 hours, send the child for IV therapy.
■ After 6 hours, reassess the child. Classify dehydration. Then choose the appropriate plan (A, B, or C) to continue treatment.
Note: If possible, observe the child for at least 6 hours after rehydration to be sure the mother can maintain hydration giving the child ORS solution by mouth.

Cholera - Suspect cholera in children over 2 years old who have acute watery diarrhoea and signs of severe dehydration, if cholera is occurring in the area.

- Assess and treat dehydration as for other acute diarrhoea.
- Give an oral antibiotic to which strains of Vibrio cholerae in the area are known to be sensitive. Possible choices are: tetracycline: 12.5mg/kg 4 times a day for 3 days or erythromycin 4 times a day for 3 days.
- Prescribe zinc supplementation as soon as vomiting stops



Figure 5.2 pinching the child's abdomen to test for decreased skin turgor

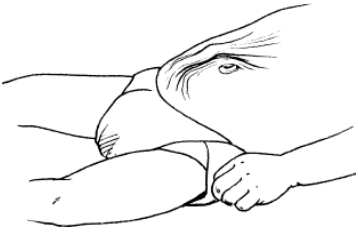


Figure 5.3 Very slow return of skin pinch in severe dehydration

Monitoring

Reassess the child every 15–30 min until a strong radial pulse is present. Thereafter, reassess the child by checking skin pinch, level of consciousness and ability to drinkat least every hour, in order to confirm that hydration is improving. Sunken eyes recover more slowly than other signs and are less

useful for monitoring.

When the full amount of IV fluid has been given, reassess the child's hydration statusfully.

- *If signs of severe dehydration are still present*, repeat the IV fluid infusion outlined earlier. Persistent severe dehydration after IV rehydration is unusual; it usually occurs only in children who pass large watery stools frequently during the rehydration period.
- *If the child is improving but still shows signs of some dehydration*, discontinue IV treatment and give ORS solution for 4 h (see section 5.2.2 and treatment plan B). If the child is usually breastfed, encourage the mother tocontinue breastfeeding frequently.
- *If there are no signs of dehydration*, follow the guidelines in section 5.1.3 and treatment plan A, when appropriate, encourage the mother tocontinue breastfeeding frequently. Observe the child for at least 6 h beforedischarge, to confirm that the mother is able to maintain the child's hydrationby giving ORS solution.

All children should start to receive some ORS solution (about 5 ml/kg per h) by cup when they can drink without difficulty (usually within 3–4 h for infants and 1–2 h for older children). ORS provides additional base and potassium, which may not be adequately supplied by IV fluid. When severe dehydration is corrected, prescribe zinc.

5.2.2 **Some Dehydration**

In general, children with some dehydration should be given ORS solution, for the first 4 hours at a clinic while the child is monitored and the mother is taught how to prepare and give ORS solution.

Diagnosis

If the child has two or more of the following signs, the child has some dehydration:

- Restlessness/irritability
- Thirsty and drinks eagerly
- Sunken eyes
- Skin pinch goes back slowly.

Note that if a child has only one of the above signs and one of the signs of severe dehydration (e.g. restless/irritable and drinking poorly), then that child also has some dehydration.

Treatment

- In the first 4 hours, give the child the approximate amounts of ORS solution, according to the child's weight (or age if the weight is not known). However, if the child wants more to drink, give more.
- Replace the ongoing loss (10ml/kg/bowel motion or vomiting)
- Show the mother how to give the child ORS solution, a teaspoonful every 1–2 minutes if the child is under 2 years; frequent sips from a cup for an older child.
- Check regularly to see if there are problems.
  - If the child vomits, wait 10 minutes; then, resume giving ORS solution more slowly (e.g. a spoonful every 2–3 minutes).
  - If the child's eyelids become puffy, stop ORS solution reduce the fluid intake and continue with breast milk. Weigh the

child, and monitor urine out put.

- Check blood glucose or electrolytes if possible in a child who is restless or irritable and convulsing, in case hypoglycaemia or hypernatraemia is present. Manage the child accordingly; if blood glucose measurement is not possible, give IV glucose or oral sugar.
- If the mother cannot stay for 4 h, show her how to prepare ORS solution and give her enough ORS packets to complete rehydration at home plus enough for 2 more days.
- Reassess the child after 4 h, checking for signs of dehydration listed earlier.

Note: *Reassess the child before 4 h if he or she is not taking the ORS solution or seems to be getting worse.*

- *If there is no dehydration*, teach the mother the four rules of home treatment:
  (i) Give extra fluid.
  (ii) Give zinc supplements for 10 – 14 days.
  (iii) Continue feeding (see Chapter 10).
  (iv) Return if the child develops any of the following signs:
    - Drinking poorly or unable to drink or breastfeed
    - Develops a general danger sign
    - Becomes sicker
    - Develops a fever
    - Has blood mixed with the stools or more than a few drops on theoutside of the stool
- *If the child still has some dehydration*, repeat treatment with

ORS solution for another 4 h, as above, and start to offer food, milk or juice and breastfeed frequently.

- *If there are signs of severe dehydration*, see section 5.2.1 for treatment.

Give zinc supplements. Give zinc and advise the mother how much to give:

≤ 6 months: half tablet (10 mg) per day for 10–14 days

≥ 6 months: one tablet (20 mg) per day for 10–14 days

Feeding

Continuation of nutritious feeding is an important element in the managementof diarrhoea.

- In the initial 4-h rehydration period, do not give any food except breast milk. Breastfed children should continue to breastfeed frequently throughout the episode of diarrhoea. If they cannot suck from the breast, consider giving expressed breast milk either orally from a cup or by nasogastric tube.
- After 4 h, if the child still has some dehydration and ORS continues to be given, give food every 3–4 h.
- All children > 6 months should be given some food before being sent home.

If the child is not normally breastfed, explore the feasibility of **relactation** (i.e. restarting breastfeeding after it was stopped, see chapter 7) or give the usual breast milk substitute. If the child is ≥ 6 months or already taking solid food, give freshly prepared foods – cooked, mashed or ground. The following are recommended:

- Cereal or another starchy food mixed with pulses, vegetables and meat or fish, if possible, with 1–2 teaspoons of vegetable oil added to each serving

- Local complementary foods recommended by the IMCI in that area (see chapter 10
- Fresh fruit juice or mashed banana to provide potassium.
- Encourage the child to eat by offering food at least six times a day. Give the same foods after the diarrhoea stops, and give an extra meal a day for 2weeks.

Chart 5.2 Diarrhoea Treatment Plan B: Treat some dehydration with ORS

RECOMMENDED AMOUNT OF ORS IN CLINIC OVER 4-HOUR PERIOD

➤ **Determine amount of ORS to give during first 4 hours.**

AGE*	Up to 4 months	4 months up to 12 months	12 months up to 2 years	2 years up to 5 years
WEIGHT	<6 kg	6–<10 kg	10–<12 kg	12–19 kg
In ml	200–400	400–700	700–900	900–1400

* *Use the child's age only when you do not know the weight. The approximate amount of ORS required (in ml) can also be calculated by multiplying the child's weight (in kg) by 75.*

— If the child wants more ORS than shown, give more.

➤ **Show the mother how to give ORS solution.**

— Give frequent small sips from a cup.

— If the child vomits, wait 10 minutes. Then continue, but more slowly.

— Continue breastfeeding whenever the child wants.

■ **After 4 hours:**

— Reassess the child and classify the child for dehydration.

— Select the appropriate plan to continue treatment.

— Begin feeding the child in clinic.

➤ **If the mother must leave before completing treatment:**

— Show her how to prepare ORS solution at home.

— Show her how much ORS to give to finish 4-hour treatment at home.

— Give her enough ORS packets to complete rehydration. Also give her 2 packets as recommended in Plan A.

— Explain the 4 Rules of Home Treatment:

1. **Give extra fluid**
2. **Give zinc supplements**
3. **Continue feeding**
4. **When to return**

See Diarhoea treatment plan A (Chart 5.3) and Mothers card (section 12.2)

5.2.3 No dehydration

Children with diarrhoea but no dehydration should receive extra fluids at home to prevent dehydration. They should continue to receive an appropriate diet for their age, including continued breastfeeding.

Diagnosis - Diarrhoea with no dehydration should be diagnosed if the child does not qualify for some or severe dehydration:

Treatment

- Treat the child as an outpatient. See Treatment plan A
- Counsel the mother on the 4 rules of home treatment (chart 5.3).
- Give extra fluid, as follows and as much as the child will take:
  - If the child is being breastfed, advise the mother to breastfeed frequently and for longer duration at each feed.
  - If the child is exclusively breastfed, give ORS solution or clean water in addition to breast milk.
  - After the diarrhoea stops, for infants less than 6 months of age exclusive breastfeeding should be resumed, if appropriate to the child's age.
- In non-exclusively breastfed children, give one or more of the following:
  - ORS solution
  - Food-based fluids (such as soup, rice water and yoghurt drinks)
  - Clean water
- Tell the mother to give small sips from a cup. If the child vomits, wait 10 minutes and then give more slowly. She should

continue giving extra fluid until the diarrhoea stops.

- Teach the mother how to mix and give ORS solution and give her two packets of ORS to take home.
- Give zinc supplements and show the mother how to give it
- Continue feeding
- Advise the mother on when to return—see above.

Chart 5.3 Diarrhoea Treatment Plan A: Treat diarrhoea at home

COUNSEL THE MOTHER ON THE 4 RULES OF HOME TREATMENT:GIVE EXTRA FLUID, CONTINUE FEEDING, WHEN TO RETURN, GIVE ZINC SUPPLEMENTS

1. GIVE EXTRA FLUID (AS MUCH AS THE CHILD WILLTAKE)

➢**TELL THE MOTHER:**

- Breastfeed frequently and for longer at each feed.
- If the child is exclusively breastfed, give ORS or clean water in addition to breastmilk.
- If the child is not exclusively breastfed, give one or more of the following: ORS solution, food-based fluids (such as soup, rice water, and yoghurt drinks), or clean water.

It is especially important to give ORS at home when:

- the child has been treated with Plan B or Plan C during this visit.
- the child cannot return to a clinic if the diarrhoea gets worse.

➢**TEACH THE MOTHER HOW TO MIX AND GIVE**

ORS. GIVE THE MOTHER 2 PACKETS OF ORS TO USE AT HOME.

➢**SHOW THE MOTHER HOW MUCH FLUID TO GIVE**

IN ADDITION TO THE USUALFLUID INTAKE:

- Up to 2 years - 50 to 100 ml after each loose stool
- 2 years or more - 100 to 200 ml after each loose stool

Tell the mother to:

- Give frequent small sips from a cup.
- If the child vomits, wait 10 minutes. Then continue, but more slowly.
- Continue giving extra fluid until the diarrhoea stops.

2. GIVE ZINC SUPPLEMENTS

➢TELL THE MOTHER HOW MUCH ZINC TO GIVE:

- Up to 6 months 1/2 tablet (10 mg) per day for 10 days
- 6 months and more 1 tablet (20 mg) per day for 10 days

➢SHOW THE MOTHER HOW TO GIVE THE ZINC SUPPLEMENTS:

- Infants, dissolve the tablet in a small amount of clean water, expressed milk or ORS in a small cup or spoon.
- Older children, tablet can be chewed or dissolved in a small amount of clean water in a cup or spoon.

➢REMIND THE MOTHER TO GIVE THE ZINC FOR THE FULL 10 DAYS.

3. CONTINUE FEEDING

4. WHEN TO RETURN

See Mother's card

5.3 Persistent diarrhoea

Persistent diarrhoea is diarrhoea, with or without blood, which begins acutely and lasts for 14 days or longer. When there is some or severe dehydration, persistent diarrhoea is classified as "severe".

The following guidelines are for children with persistent diarrhoea who are not severely malnourished. Suspect and screen for HIV.

5.3.1 Severe persistent diarrhoea

Diagnosis

- Infants or children with diarrhoea lasting ≥ 14 days, with signs of dehydration have severe persistent diarrhoea and require hospital treatment.

Treatment

- Assess the child for signs of dehydration and give fluids according to Treatment Plans B or C, as appropriate.

ORS solution is effective for most children with persistent diarrhoea. In a few, however, glucose absorption is impaired and ORS solution is not effective.

Routine treatment of persistent diarrhoea with antibiotics is not effective and should not be given. Some children, however, have non-intestinal or intestinal infections that require specific antibiotic therapy.

- Examine every child with persistent diarrhoea for non-intestinal infections such as pneumonia, sepsis, urinary tract infection, oral thrush, and otitis media and treat appropriately.
- Give micronutrients and vitamins.
- Treat persistent diarrhoea with blood in the stool with an oral antibiotic effective for Shigella (section 5.4)
- Give treatment for amoebiasis (oral metronidazole: 30-50 mg/kg, 3 times a day, for 10 days or tinidazole 50-60mg/kg per day for 3 days) only if:
    - Microscopic examination of fresh feces carried out in a reliable laboratory reveals trophozoites of Entamoebahistolytica within red blood cells; OR

- Antibiotic, which is usually effective for Shigella locally, have been given without clinical improvement.

- Give treatment for giardiasis (metronidazole: 15 mg/kg, 3 times a day, for 5 days or Tinidazole 50-75mg/kg po stat) if cysts or trophozoites of Giardia lamblia are seen in the feces.

Feeding

Careful attention to feeding is essential for all children with persistent diarrhoea.

Breastfeeding should be continued for as often and as long as the child wants. Other food should be withheld for 4–6 hours—only for children with dehydration who are being rehydrated following Treatment Plans B or C.

Hospital diets

Children treated in hospital require special diets until their diarrhoea lessens and they are gaining weight. The goal is to give a daily intake of at least 110 calories/kg.

Infants aged under 6 months

- Encourage exclusive breastfeeding. Help mothers who are not breastfeeding exclusively to do so. But beware of the increased risk of MTCT through breast milk during relactation.
- If the child is not breastfeeding, give a breast milk substitute that is low in lactose, such as yoghurt, or is lactose-free. Use a spoon or cup, do not use a feeding bottle. Once the child improves, help the mother to re-establish lactation (caution: see above, MTCT).
- For feeding of infants born to HIV positive mothers she should receive appropriate counseling about the correct use of breast milk substitutes.

Children aged 6 months or older

Feeding should be restarted as soon as the child can eat. Food should be given 3 times a day for those who are on breast or replacement milk or 5 times a day for those not on breast or replacement milk to achieve a total intake of at least 110 calories/kg/day. Many children will eat poorly, however, until any serious infection has been treated for 24–48 hours. Such children may require nasogastric feeding initially. Give the same foods after the diarrhoea stops and give an extra meal a day for 2 weeks after the diarrhoea stops for fast recovery.

Two recommended diets

Given below (Tables 5.4 and 5.5) are two diets recommended for children and infants aged >6 months with severe persistent diarrhoea. If there are signs of dietary failure (see below) or if the child is not improving after 7 days of treatment, the first diet should be stopped and the second diet given for 7 days.

Successful treatment with either diet is characterized by:

- Adequate food intake
- Weight gain
- Fewer diarrhoeal stools
- Absence of fever.

The most important criterion is weight gain. There should be at least three successive days of increasing weight before one can conclude that weight gain is occurring.

Give additional fresh fruit and well cooked vegetables to children who are responding well. After 7 days of treatment with the effective diet, they should resume an appropriate diet for their age, including milk, which

provides at least 110 calories/kg/day. Children may then return home, but follow them up regularly to ensure continued weight gain and compliance with feeding advice.

Dietary failure is shown by:

- An increase in stool frequency (usually to >10 watery stools a day), often with a return of signs of dehydration (this usually occurs shortly after a new diet is begun), OR
- A failure to establish daily weight gain within 7 days.

Table 5.4 Diet for persistent diarrhoea, first diet: A starch-based, reduced milk concentration (low lactose) diet

Food Component	Amount (g)
full-fat dried milk (or whole liquid milk: 85 ml)	11
Rice	15
vegetable oil	3.5
cane sugar	3
water to make	200ml

Table 5.5 Diet for persistent diarrhoea, second diet: A no-milk (lactose-free) diet with reduced cereal (starch)

Food Component	Amount (g)
Whole egg	64
Rice	3
Vegetable oil	4
Glucose	3
Water to make	200 ml
Finely ground, cooked chicken (12 g) can be used in place of egg to give a diet providing 70 calories/100 g.	

Monitoring

Nurses should check the following daily:

- Body weight
- Temperature
- Food taken
- Frequency of diarrhoea.

5.3.2 Persistent diarrhoea (non-severe)

These children do not require hospital treatment but need special feeding and extra fluids at home.

Diagnosis - Children with diarrhoea lasting 14 days or longer who have no signs of dehydration and no severe malnutrition

Treatment

- Treat the child as an outpatient.
- Give micronutrients and vitamins according to box (Table 5.6)

Prevent dehydration

- Give fluids according to Treatment Plan A, ORS solution is effective for most children with persistent diarrhoea. **Identify and treat specific infections**
- Do stool exam. Do not routinely treat with antibiotics as they are **not effective. However, give antibiotic** treatment to children with specific non-intestinal or intestinal infections. Until these infections are treated correctly, persistent diarrhoea will not improve.
- Non-intestinal infections. Examine every child with persistent diarrhoea for non-intestinal infections, such as pneumonia, sepsis, urinary tract infection, oral thrush and otitis media. Treat with antibiotics following the guidelines in this manual.

- Intestinal infections. Treat persistent diarrhoea with blood in the stool as per the result of stool exam.

Feeding

Careful attention to feeding is essential for all children with persistent diarrhoea. These children may have difficulty in digesting animal milk other than breast milk.

- Advise the mother to reduce the amount of animal milk in the child's diet temporarily.
- Continue breastfeeding and give appropriate complementary foods.
    - If still breastfeeding, give more frequent, longer breastfeeds, by day and night.
    - If taking other animal milk, explore the feasibility of replacing animal milk with fermented milk products (e.g. yoghurt), which contain less lactose and are better tolerated.
    - If replacement of animal milk is not possible, limit animal milk to 50 ml/kg/day. Mix the milk with the child's cereal, but do not dilute it.
    - Give other foods appropriate for the child's age to ensure an adequate caloric intake. Infants aged >6months whose only food has been animal milk should begin to take solid foods.
    - Give frequent small meals, at least 3 or 5 times a day (see above).
    - Supplementary micronutrients, including zinc (Table 5.6)

Follow-up

- Tell the mother to bring the child back for reassessment after five days, or earlier if the diarrhoea worsens or other problems develop.
- Fully reassess children who have not gained weight or whose diarrhoea has not improved in order to identify any problems, such as dehydration or infection, which need immediate attention or admission to hospital.
- Those who have gained weight and who have less than three loose stools per day may resume a normal diet for their age.

5.4 Dysentery

Dysentery is diarrhoea presenting with loose frequent stools containing blood. Most episodes are due to Shigella and nearly all require antibiotic treatment.

Diagnosis

The diagnostic signs of dysentery are frequent loose stools with visible blood.

Other findings on examination may include:

- Abdominal pain
- Fever
- Convulsions
- Lethargy
- Dehydration (section 5.2)
- Rectal prolapse.

Laboratory

- Stool exam microscopy, stool culture and sensitivity
- WBC and Differential

Treatment

Children with severe malnutrition and dysentery, and young infants (<2 months old) with dysentery should be admitted to hospital. In addition children who are toxic, lethargic, have abdominal distension and tenderness or convulsions are at high risk of sepsis and should be hospitalized. Others can be treated at home.

- Give an oral antibiotic, to which most strains of Shigella locally are sensitive:
- First line: Amoxicillin 30-50 mg/kg, 3 times a day for 10 days or tetracycline
- If child is septic and needs admission: ceftraixone (see dose above) IV. Prescribe a zinc supplement as done for children with watery diarrhoea without dehydration.

Note: There is widespread Shigella resistance to ampicillin, co-trimoxazole, chloramphenicol, nalidixic acid, tetracycline, gentamicin and first- and second generation cephalosporins, which are no longer effective. There is also already reported resistance to ciprofloxacin in some countries.

Follow-up

Follow-up children after two days, look for signs of improvement such as no fever, fewer stools with less blood, improved appetite.

- If there is no improvement after two days,
  - Check for other conditions (see Chapter 2),
  - Stop the first antibiotic, and
  - Give the child a second-line antibiotic which is known to be effective against Shigella
- If the two antibiotics, which are usually effective for Shigella, have

each been given for 2 days and produced no signs of clinical improvement,

- Repeat stool exam and treat as an outpatient if there is amoebiasis
- Check for other conditions (refer to a standard paediatric textbook).
- Admit the child if there is another condition requiring hospital treatment.

Infants and young children

Consider surgical causes of blood in the stools (for example, intussusception; and refer to a surgeon if appropriate. Dysentery is unusual in neonates and young infants; therefore, consider life-threatening bacterial sepsis.

- For suspected sepsis give IM or IV ceftriaxone at 100 mg/kg once daily for 7-10 days.

Supportive care

Supportive care includes the prevention or correction of dehydration and continued feeding.

Never give drugs for symptomatic relief of abdominal pain and rectal pain, or to reduce the frequency of stools, as they can increase the severity of the illness.

Treatment of dehydration

Assess the child for signs of dehydration and give fluids according to Treatment Plan A, B or C as appropriate.

Nutritional management

Ensuring a good diet is very important as dysentery has a marked adverse effect on nutritional status. However, feeding is often difficult because of lack of appetite. Return of appetite is an important sign of improvement.

- Breastfeeding should be continued throughout the course of the illness, more frequently than normal, if possible, because the infant may not take the usual amount per feed.
- Children aged 6 months or more should receive their normal foods. Encourage the child to eat more.

Complications

- *Dehydration*: Assess and mange for dehydration. Give fluids according to treatment plan A, B or C, as appropriate.
- Potassium depletion: This can be prevented by giving ORS solution (when indicated) or potassium-rich foods such as bananas or dark green leafy vegetables.
- High fever: If the child has high fever (≥ 39 ° C), consider systemic infection.
- Rectal prolapse: Gently push back the rectal prolapse using a surgical glove or a wet cloth. Alternatively, prepare a warm solution of saturated magnesium sulphate and apply compresses with this solution to reduce the prolapse by decreasing the oedema
- Convulsions: give diazepam but avoid rectal diazepam.
- Haemolytic-uraemic syndrome*:* Where laboratory tests are not possible, suspect haemolytic-uraemic syndrome (HUS) in patients with easy bruising, pallor, altered consciousness, and low or no urine output and Refer immediately

- Toxic megacolon: Toxic megacolon usually presents with fever, abdominal distension, pain and tenderness with loss of bowel sounds, tachycardia and dehydration. Give IV fluids for dehydration, pass a nasogastric tube,and start antibiotics. Consult surgeon or refer.
- Treat hypoglycemia

CHAPTER 6 – FEVER

6.1 Child presenting with fever

6.1.1 Fever lasting 7 days or less

History

- Duration and pattern of fever
- Residence in or recent travel to a malaria endemic area
- Recent contact with a person with an infectious disease and/or similar diseases in the vicinity
- Pain on swallowing,
- Skin rash
- Headache
- Stiff neck or neck pain
- Change of sensorium
- Convulsion
- Pain (crying) on passing urine, change in urine color (turbid), smelly urine
- Respiratory symptoms like cough
- Ear pain/ discharge
- GI symptoms
- Vomiting
- Jaundice
- history of vaccination

Examination

General condition: level of consciousness, pallor, signs of respiratory distress, cyanosis

Vital sign: temperature, pulse rate, respiratory rate, blood pressure, oxygen saturation

Head and neck: icteric sclera , bulged fontanel , stiff neck, red swollen tonsils, follicles, mouth ulcer, discharge from ear, swelling and tenderness behind ear and red ear-drum on otoscopy,

Chest: fast breathing, retraction, crepitation

Abdomen: hepatosplenomegaly

Limbs: joint swelling, limitation of movement of joints.

Skin examination :

- Pallor: anemia
- Rash
- Pustules, or signs of infection: red, hot, swollen, tender (staphylococcal infection)
- Haemorrhagic rash: purpura, petechiae (meningococcal infection)
- Maculopapular rash (measles, other viral infections)

Meningeal signs

Laboratory investigations

- Blood smear
- Urine microscopy and culture
- Complete blood count
- Lumbar puncture if indicated (sign suggest or not sure)
- Blood culture

Differential Diagnoses

There are four major categories of children presenting with fever:

- Fever due to infection with out-localized signs (no rash)
- Fever due to infection with localized signs (no rash)
- Fever with rash
- Fever lasting more than 7 days

Table 6.1 Differential diagnosis of fever without localizing signs

Diagnosis of fever	In favour
Malaria	Living in endemic area Travel history Anaemia Enlarged spleen Blood film positive, RDT
Septicaemia	Seriously and obviously ill with no apparent cause Purpura, petechiae Shock or hypothermia in young infant or severely malnourished child
Urinary tract infection	Abdominal pain Loin or suprapubic tenderness Crying on passing urine Passing urine more frequently than usual Incontinence in previously continent child White blood cells and/or bacteria in urine on microscopy, or positive dipstick
Fever associated with HIV infection	Signs of HIV infection (see Chapter 8)
Typhoid	Seriously and obviously ill with no apparent cause Abdominal tenderness Shock, confusion

Table 6.2 Differential diagnosis of fever with localized signs

Diagnosis of fever	In favor
Meningitis	Convulsion Altered level of consciousness Bulging fontanels in infant Stiff neck Petechiae or purpura CSF analysis positive
Acute Otitis media	Ear pain Pus draining from ear Red immobile ear-drum on Otoscopy
Mastoiditis	Tender swelling above or behind ear
Osteomyelitis	Refusal to move the affected limb Refusal to bear weight on leg Local tenderness
Septic arthritis	Swollen hot, tender joint
Skin and soft tissue infection	Cellulitis Boils Skin pustules Pyomyositis (purulent infection of muscle)
Pneumonia (see section 4.1)	Fever ,Cough, Grunting nasal flaring, lower chest wall indrawing Coarse crackles Bronchial breath sound Bronchopneumonic infiltrations Lobar consolidation Pleural effusion
Viral upper respiratory	Runny nose , symptoms of cough / cold

tract infection	No systemic upset
Retropharyngeal abscess	History of recent sore throat in older child Difficulty in swallowing/drooling of saliva Tender cervical node
Sinusitis	Tender cervical nodes facial tenderness over affected sinus Foul nasal discharge
Urinary tract infection	Crying on passing urine Passing urine more frequently than usual Incontinence in previously continent child Costo-vertebral angle or suprapubic tenderness White blood cells and/or bacteria in urine on microscopy, or positive dipstick
Hepatitis	Severe anorexia Abdominal pain Jaundice Dark urine

Table 6.3 Differential diagnosis of fever with rash

Diagnosis of fever	In favour
Measles	Recent exposure to a measles case No documented measles immunization Cough, runny nose, red eyes Maculopapular rash Mouth ulcers Corneal clouding
Viral infections	Cough or cold Mild systemic upset Transient non-specific rash
Meningococcal infection	Petechial or purpuric rash Bruising Shock Stiff neck (if meningitis)
Relapsing fever	Poor living condition/overcrowding, homeless Petechial rash / skin haemorrhages Jaundice Tender enlarged liver and spleen History of relapsing fever Positive blood smear for Borrelia
Typhus	Epidemic of typhus in region Characteristic macular rash Muscle pain
Dengue haemorrhagic fever	Bleeding from nose or gums or in vomitus Bleeding in stools or black stools Skin petaechiae or purpura Abdominal tenderness Enlarged liver and spleen Shock

6.1.2 Fever lasting longer than seven days

History: take history as fever … see section 6.1.1

Examination

Fully undress the child, and examine the whole body and look for the following signs:

- Inflamed throat and mucous membranes (throat infection)
- Red, painful ear with immobile ear-drum (otitis media)
- Fast breathing or chest indrawing (pneumonia, empyema)
- Stiff neck or bulging fontanel (meningitis, subdural abscess)
- Petechial or purpuric rash (meningococcal disease or dengue)
- Maculopapular rash (viral infection or drug reaction)
- Jaundice or anaemia (malaria, hepatitis, leptospirosis or septicaemia)
- Painful spine, hips or other joints (septic arthritis)
- Tender abdomen (suprapubic or loin in urinary tract infection)
- Malar rash , pallor ,(Autoimmune diseases such as SLE)
- Lymphadenopathy, pallor, petechial rash (Malignancy)
- Pallor, splenomegaly, petechiae (visceral leishmaniasis)
- Other causes of persistent fever with no localizing signs such as septicemia, *Salmonella* infections, miliary TB, HIV infection or urinary tract infection.

Laboratory investigations

- Blood films or rapid diagnostic test for malaria parasites (a positive test in an endemic area does not exclude other, co-existing causes of fever)

- Complete blood count, including platelet count, and examination of a thin film for cell morphology
- Urinalysis, including microscopy
- Mantoux test, if available (*Note:often negative in a child who has miliary TB, severe malnutrition or HIV infection*)
- Chest X-ray
- Blood culture
- lumbar puncture (to exclude meningitis if there are supportive signs)
- HIV testing
- Widal (rising titer)
- Weil Felix
- Splenic/bone marrow aspiration

6.1.3 Differential Diagnosis

Review all the condition listed in Table 6.1-6.4

Table 6.4 Additional differential diagnosis of fever lasting longer than 7 days

Diagnosis	In favour
Abscess	Fever with no obvious focus of infection (deep abscess) Local tenderness or pain Tender or fluctuant mass Specific signs depend on site—sub phrenic, psoas, liver abscess
Salmonella infection (non-typhoidal)	Child with sickle-cell disease Osteomyelitis or arthritis in infant

Infective endocarditis	Known cardiac lesion/Heart murmur Fever Weight loss Pallor Petaechiae Splinter haemorrhages in nail beds Finger clubbing Enlarged spleen Normocytic normochromic anaemia Microscopic haematuria
Rheumatic fever	Recent known streptococcal infection Migratory poly arthritis/arthralgia Carditis Fast pulse rate not proportional to the degree of fever Pericardial friction rub Chorea Mitral and /or aortic regurgitation murmur Positive ASO titer
Miliary tuberculosis	Cough Weight loss Anorexia, night sweats Contact to TB patient Enlarged liver and/or spleen Fine miliary pattern on chest X-ray
Brucellosis	Chronic relapsing or persistent fever, malaise Musculoskeletal pain Lower backache or hip pain Enlarged spleen, anaemia, history of drinking unboiled milk

6.2 Malaria

6.2.1 Severe malaria

Severe malaria, which is commonly due to Plasmodium falciparum, is serious enough to be an immediate threat to life.

Diagnosis

History

A child who has fever or history of fever and lives in malaria-endemic areas or has a history of travel within the last 30 days to malaria-endemic areas and positive for asexual parasitaemia and presence of one or more of the following clinical or laboratory features is considered to have severe malaria:

- Prostration: inability to sit unassisted in a child who is normally able to do or inability to feed in young children not yet started to sit
- Multiple convulsion more than two episodes in 24 hrs.
- Impaired consciousness : Blantyre Coma Scale < 3 in infants, Glasgow Coma Scale < 11 in older children and adolescent
- Respiratory distress or in-drawing of chest wall
- Frothy blood tinged sputum
- Circulatory collapse or shock
- Bleeding tendency/abnormal bleeding
- Jaundice
- Severe pallor
- Dark cola colored urine
- systolic blood pressure lower than 5th centile for age and sex

Laboratory findings

- Hypoglycemia (<2.2 mmol/L or < 40 mg/dL)

- Parasitic load (2% in low intensity transmission and >20% in high transmission area)
- Severe anemia (hemoglobin <5g/dl, haematocrit< 15%)
- Acidosis (bicarbonate <15 mmol/L)
- Hyperlactatemia : >5mmol/l
- Renal impairment: Urine output <1ml/kg/hr for infants and 0.5 ml/kg/hr for children; or creatinine level above age related normal range
- Haemoglobinuria: Dark red or black urine, dipstick positive for hemoglobin/myoglobin, no microscopic hematuria
- Cerebrospinal fluid analysis to rule out meningitis is mandatory if no contraindication to do LP in children with altered consciousness

Treatment

Emergency measures—to be taken within the first hour:

- In unconscious patient keep the air way open, insert NG tube and remove the gastric contents, and place in recovery position
- Check for hypoglycemia and correct accordingly. If blood glucose can't be determine give glucose
- Treat convulsions with I.V or rectal diazepam (Chapter 2, chart 9). Do not give prophylactic anticonvulsants.
- Treat high grade fever with paracetamol or ibuprofen to reduce temperature below 39^0c.
- Check for dehydration and treat appropriately.
- Correct the anemia.
- Institute regular observation of vital and neurologic signs.

- Start treatment with an effective antimalarial.

Antimalarial Treatment

- If blood smear confirmation of malaria is likely to take more than one hour, start antimalarial treatment immediately before the diagnosis is confirmed.
- In severe malaria treatment has to be given always parenteral route (IV, IM) until the child tolerate P0 medication. Even if the child tolerates PO medication earlier, give the parenteral medication for at least 24 hrs.
- If severe malaria is suspected on clinical findings and the blood smear is negative, repeat the blood smear. If the 2nd test is negative, malaria is unlikely and look for alternative diagnosis.

The first line treatment of severe malaria

- Artesunate 2.4 mg/kg IV or IM given on admission (time = 0), then at 12 h and 24 h, then once a day for 6 days or until the child tolerates PO medication. If the patient tolerates after 24 h, the medication can be changed to PO Artesunate-Lumefantrine for the next three days.

- The injectable artesunate (Guilin Pharmaceutical Co, Guanxi, China) contains 60 mg powder within a 7 ml glass vial that must first be reconstituted by mixing with a 1 ml glass ampoule of 5% sodium bicarbonate solution (provided) prior to administration and then shaken 2-3 minutes for better dissolution.

- To prepare an IV infusion of artesunate (10 mg/ml), next add 5 ml of 5% glucose (D5W) or Normal Saline to the just-reconstituted 7 ml vial, then infuse slowly intravenously (i.e. 3-4 ml per minute IV).

- To prepare artesunate for IM injection, add 2 ml of 5% glucose (D5W) or Normal Saline to the reconstituted 7 ml vial to make 3 ml of artesunate (20 mg/ml) for IM injection.

Table 6.5 Reconstituted Artesunate dosage for treatment of severe malaria

Weight (kg) (approximate)	IV 10 mg/ml	IM 20 mg/ml
0-8	1 ml	0.5 ml
9 to 12	2 ml	1 ml
13-16	3 ml	1.5 ml
17-18	4 ml	2 ml
19-21	5 ml	2.5 ml
22-25	6 ml	3 ml
26-29*	7 ml	3.5 ml
30-33*	8 ml	4 ml
34-37*	9 ml	4.5 ml
38-41*	10 ml	5 ml
42-46*	11 ml	5.5 ml
47+*	12 ml	6 ml

*Note that for persons weighing more than 25 kg, a second artesunate vial must be completely reconstituted as above for each dose, and then each dose administered determined by the chart.

If Artesunate not available, give quinine

Quinine Dosage:

- Loading dose: 20 mg/kg of quinine dihydrochloride salt in 5-10 ml/kg of IV fluid preferably 5% glucose over a period of 4 hours. Then continue with 10 mg/kg quinine salt in IV fluid over 4 hours TID (8 hrly) until the child is able to take oral treatment.

- Wherever IV administration of quinine is not possible: give Quinine dihydrochloride 20 mg salt per kg loading dose intramuscularly (divided in to two sites, anterior thigh) the quinine should be diluted in sterile normal saline to a concentration of 60mg/ml. Then continue with quinine dihydrochloride 10 mg salt per kg IM every 8 hours until patient can swallow. Diluted parenteral solution is better absorbed and less painful.

- If the child tolerate oral medication continue with PO Artemether-lumefantrine (AL) (table 6.6) unless contraindicated or Quinine 10 mg/kg PO every 8 h to complete for 7 days of treatment.

- *If Artesunate and quinine not available then give* Artemether at the dose of 3.2 mg/kg IM on admission, then 1.6 mg/kg daily until the child can take oral medication. Use a 1-ml tuberculin syringe to give the small injection volume

Table 6.6 Dose of Tablet containing 20 mg Artemether plus 120 mg Lumefantrine in a fixed dose combination

Weight (kg)	Age (Years)	Number of tablets per dose -Twice daily for 3 days					
		Day1		Day2		Day3	
		Morning	Evening	Morning	Evening	Morning	Evening
5 – 14	3 Months – 2 years	1	1	1	1	1	1
15 – 24	3 – 7 years	2	2	2	2	2	2
25 – 34	8 – 10 years	3	3	3	3	3	3
35+	>10 Years	4	4	4	4	4	4

Supportive care

- Provide meticulous nursing care, especially for unconscious patients.
- Correct hypoglycaemia and control fever using antipyretics such as paracetamol.
- Monitor the daily input and output and hydration status and provide daily fluid requirements accordingly
- Feed children unable to feed for more than 1–2 days by nasogastric tube, which is preferable to prolonged IV fluids.
- Avoid giving any harmful drugs like corticosteroids, low-molecular-mass dextran and other anti-inflammatory drugs

For unconscious child:

- Maintain a clear airway
- Protect eyes, mucosae, skin.
- Nurse the child on the side to avoid aspiration of fluids.
- Turn the patient every 2 hours.
- Do not allow the child to lie in a wet bed.
- Pay attention to pressure points.
- Asses hydration status
- If there is sign of dehydration treat accordingly
- If after careful rehydration, the urine output over 6 hours is less than 0.5ml/kg/hr, give IV furosemide, initially at 2mg/kg body weight. If there is no response, double the dose at hourly intervals to a maximum of 8 mg/kg body weight given over 15 minutes
- Look for signs of overload such as enlarged liver, gallop rhythm, fine crackles at lung base, engorged neck veins, eye lid edema

Management of some of the Complications

Coma (cerebral Malaria)

- Assess the level of consciousness according to Blantyre coma scale (Table 6.7) for children and Glasgow coma scale for older children and adolescents. Monitor temperature respiratory rate, heart rate, blood pressure and urine output.
- Provide meticulous nursing care and pay careful attention to the airway, eyes, mucosae, skin and fluid requirements.
- Exclude other treatable causes of coma (e.g. hypoglycaemia, bacterial meningitis) and/or treat accordingly
- Manage convulsion if present

Table 6.7 Blantyre coma scale for young children

	Score
Eye movements: Directed (followed mother/caretakers face) Not directed	 1 0
Verbal response: Appropriate for age (cry) Moan or inappropriate for age (cry) Gasp/none	 2 1 0
Best motor response: Localizes painful stimulus (rub your knuckles firmly on the patients sternum) Withdraws limb from pain (press firmly on patients thumbnail bed with the side of a horizontal pencil) None specific or absent response	 2 1 0
Total	1-5

Convulsions: are common before and after the onset of coma. Can be manifested as subtle such as nystagmus, twitching of corner of the mouth or irregular breathing pattern or typical tonic clonic seizure.

Treatment

Anticonvulsant: give rectal diazepam or IV injection (chapter 1 chart 9)

- Correct any possible contributing cause such as hypoglycaemia, or very high fever give paracetamol.
- If there are repeated convulsions, give Phenobarbital. (Appendix.2)

Shock

Shock manifested with cold extremities (clammy skin), weak rapid pulse, and capillary refill ≥ 3 seconds and low blood pressure. The cause can be hypovolemia or sepsis.

Treatment

- Correct hypovolaemia as appropriate.
- Take blood for culture.
- Do urinalysis.
- Give both antimalarial and antibiotic treatment for septicaemia (see section 6.5,).

Severe anaemia (see chapter 10)

Give a blood transfusion as soon as possible :

- All children with a hematocrit of <12% or Hb of < 4 g/dL
- Less severely anemic children (Hct 12-15%; Hb 4- 5 g/dl) with very high parasitaemia (>20% of red cells parasitized),
- Repeat the transfusion if Hb remains low.
  - Initiate a daily iron syrup or tablet and monitor after 14 days for the response and continue for three months.

- Note that other causes of anemia must be looked for before patient is discharged and treated accordingly.

Hypoglycaemia

- Hypoglycaemia: (blood glucose: <2.5 mmol/l or <45 mg/dl) is particularly common in children under 3 years old, in children with convulsions or hyperparasitaemia, and in comatose patients. It is easily overlooked because clinical signs may mimic cerebral malaria.

- Give 5ml/kg 10% dextrose solution IV rapidly followed by continuous infusion of 6-8mg/kg/min adjusting the rate to maintain the blood glucose level in the normal range. Recheck the blood glucose level in 30 minutes.

- 1 ml/kg of 50% dextrose diluted with an equal volume of normal saline IV slowly over several minutes *OR*

- 5 ml/kg of 10% dextrose by slow IV infusion

- In unconscious child prevent further hypoglycemia by initiating NG feeding once the child is fully conscious. Start feeding with PO. Continue to monitor the blood glucose level, and treat accordingly if found to be <2.5 mmol/l or <45 mg/dl.

Acidosis

The child presents with deep, laboured breathing while the chest is clear—often accompanied by lower chest wall indrawing.

Treatment

- Give intranasal oxygen
- Correct reversible causes of acidosis, especially dehydration and severe anaemia.

- If child is not severely anemic (Hb is ≥ 5 g/dl), give 20 ml/kg of normal saline or an isotonic glucose-electrolyte solution IV over 30 minutes.
- If child is severely anemic (Hb is <5 g/dl), give whole blood (10 ml/kg) over 30 minutes, and a further 10 ml/kg over 1–2 hours without diuretics. Check the respiratory rate and pulse rate every 15 minutes. If either of these shows any rise, transfuse more slowly to avoid precipitating pulmonary oedema.
- Monitor response: clinical observation, pulse oximetry, Hct, blood glucose

Aspiration pneumonia

- Place the child on his or her side or at least 30° head-up.
- Give oxygen, if there is cyanosis, severe lower chest wall indrawing or increased respiratory rate for the age. SaO_2 is <90%,
- Ampicillin and gentamicin IV for seven days

Monitoring for severe Malaria

- The child should be checked by nurses hourly and by a doctor at least (every six hr.) Monitor and report immediately any change in the level of consciousness, convulsions, or changes in the child's behavior.
- Monitor the temperature, pulse rate, respiratory rate (and, if possible, blood pressure) hourly at least for the first 48 hours.
- Monitor the blood glucose level every 3 hours until the child is fully conscious.
- Check the rate of IV infusion regularly.
- Keep a careful record of fluid intake (including IV) and output.

6.2.2 Uncomplicated malaria

Diagnosis - The child has:

- Fever (temperature ≥ 37.5 ° C or history of fever, and
- A positive blood smear for malaria, no signs of severe malaria

Note: If a child is from malarious area and has fever with no obvious cause and it is not possible to confirm malaria on a blood film, treat the child as case of malaria.

Treatment depends on the plasmodium species.
P. Falciparum: The first-line treatment of Falciparum malaria is Artemether-lumefantrine (combined tablets containing 20 mg of Artemether and 120 mg of Lumefantrine):

Dosage for combined tablet:

- Child weighing 5 – < 15 kg: one tablet twice a day for 3 days
- Child weighing 15–24 kg: 2 tablets twice a day for 3 days
- Child > 25 kg: 3 tablets twice a day for 3 days
- Child weight less than five kilogram administer oral quinine 8.3 mg/kg base or 10 mg/kg quinine sulfate salt THREE times a day for 7 days
- *P.vivax, P. malariae, P. ovale*: the first-line drug of choice is chloroquine 10 mg base/kg PO immediately (Day 1), followed by 10 mg base/kg PO at 24 hours (Day 2), and 5mg base/kg PO at 48 hours (Day 3) for a total dose of 25 mg chloroquine base/kg over three days.
- If the child is from malaria free area and the compliance is guaranteed administer primaquine daily for 14 days to eradicate the hypnozoite form from the liver after completing the chloroquine dose.

- Multi-species RDT is positive for P. falciparum and P. vivax (mixed infection): The recommended first-line treatment for mixed infection is AL. Note: do not treat a patient with confirmed mixed infection with both AL and chloroquine
- AL May be used to treat P.vivax infection when chloroquine is unavailable. If AL is not available for *P. falciparum* or mixed malaria infections, use oral quinine. If both chloroquine and AL are not available for *P.vivax* infection, use quinine
- Severe malaria due to vivax (although not common) has to be treated as severe malaria caused by P. falciparum.

Table 6.8 Dose of Chloroquine

Weight (kg)	Age (years)	Day 1	Day 2	Day 3
5 – 6	<4 months Tablets Syrup	 1/2 5 ml	 1/4 5 ml	 1/4 2.5 ml
7 – 10	4 – 11months Tablets Syrup	 1/2 7.5 ml	 1/2 7.5 ml	 1/2 5 ml
11 – 14	1 – 2 years Tablets Syrup	 1 12.5 ml	 1 12.5 ml	 1/2 7.5 ml
15 – 18	3 – 4 years Tablets Syrup	 1 15 ml	 1 15 ml	 1 15 ml
19 – 24	5 – 7 years Tablets Syrup	 1 1/2 20 ml	 1 1/2 20 ml	 1 15 ml
25 – 35	8 – 10 years Tablets	 2 ½	 2 ½	 1
36 – 50	11 – 13 years Tablets	 3	 3	 2
50+	14+ years Tablets	 4	 4	 2

Complications

Anaemia

- If the Hb is 5–9.3 g/dl (Hct 15–27%) it indicates moderate anemia. Begin treatment with iron and folate immediately after completion of antimalarial treatment or on discharge. Give a daily iron–folate tablet or iron syrup for 14 days (Evaluate the response and continue the treatment for 3 months.
- Deworming with mebendazole. If the child is > 1 year and has not received Mebendazole in the previous six month.
- Advise the mother about good feeding practice.

Follow-up

- Tell the mother to return if the fever persists for two days after starting treatment or sooner if the child's condition gets worse. She should also return if the fever comes back.
- Check if the child actually took full treatment and repeat a blood smear.
- If the treatment was not taken repeat the same medication and dose.
- Blood smear is still positive despite full treatment, treat with a second-line antimalarial (see above) and reassess the child to exclude the possibility of other causes of fever.
- If the fever persists after two days of treatment with the second-line antimalarial, ask the mother to return with the child and reassess for other causes of fever.

6.3 Meningitis

6.3.1 Bacterial meningitis

Early diagnosis is essential for effective treatment.

Diagnosis

History:

- Vomiting
- Fever
- Irritability
- Inability to drink or breastfeed
- A headache or pain in back of neck
- Convulsions
- Similar problems in the vicinity (usually with meningococcal infection)
- Recent head injury.

Examination:

- Altered level of consciousness (irritability , lethargy, coma)
- V/S: temperature, PR,BP
- bulged fontanelle
- Stiff neck and other meningeal irritation signs
- Petechial rash or purpura
- Evidence of head trauma suggesting possibility of a recent skull fracture
- Also, look for any of the following signs of raised intracranial pressure:
- Unequal pupils
- Rigid posture or posturing and focal paralysis in any of the limbs or trunk

- Irregular breathing



Figure 6.1: Looking and feeling for stiff neck in a child

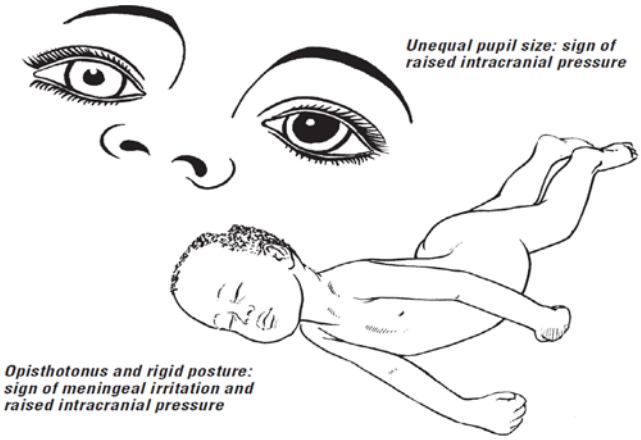

Unequal pupil size: sign of raised intracranial pressure
Opisthotonus and rigid posture: sign of meningeal irritation and raised intracranial pressure

Figure 6.2: Dilated pupil and opisthotonus

Laboratory investigations

- Confirm the diagnosis with examination of the CSF. If the CSF is cloudy, assume meningitis and start treatment while waiting for laboratory confirmation.

- Microscopy should indicate the presence of meningitis in the majority of cases with the increased white cell count (WBC > 5 cells predominately polymorphs). Confirmatory information can be gained from the CSF glucose (a ratio of CSF to serum glucose of ≤ 0.4), CSF protein (high: 400 mg/dl), and positive Gram staining and culture of the CSF, where possible.

- LP is contraindicated If there are signs of increased intracranial pressure (unequal pupils, rigid posture, lateralizing sign, irregular breathing), sever cardiorespiratory distress, and infection at the site of LP.

- Do Blood culture if available

Treatment

If there is any suspicion, treat immediately with antibiotics before the results of laboratory CSF examination are available. If the child has signs of meningitis and a lumbar puncture is not possible, treat immediately.

Antibiotic treatment

Give antibiotic treatment as soon as possible. Choose one of the following two regimens:

First line

- Crystalline penicillin loading dose of 250,000 IU/ kg IV. stat followed by 500,000 IU/kg/24 hours IV divided in 8 doses (Q3 hourly) PLUS
- Chloramphenicol, 50 mg/kg IV stat followed by 100mg/kg/day IV Q6 hourly

- Haemophilus Influenza B: Chloramphenicol, 100mg/kg/day I.V Q 6hourly for 10 days
- Pneumococcus : penicillin G 500,000IU /kg/day I.V Q 3 hourly for 14 days
- Meningococcus: penicillin G 500,000IU /kg/day i.v. Q 3hourly for 7 days

OR

Second line antibiotic

- Ceftriaxone, 100mg/kg IV, in two divided doses for 10 days for all cases.

Steroid treatment

The recommended dexamethasone dose in bacterial meningitis is 0.15 mg/kg every 6 h for 48 h. Steroids should be given within 10–20 min before or during administration of antibiotics.

Do not use steroids in:

- Suspected cerebral malaria
- Suspected viral encephalitis

Poor response for treatment

Complication such as subdural effusion, cerebral abscess (persistant fever, focal neurologic signs or altered consciousness). If these complications are suspected, refer the child to hospital with specialized facilities for further diagnostics and treatment.

- look for other sites of infection such as cellulitis , arthritis, or osteomyelitis
- check for the possibilities of
- Tuberculous meningitis

- Cryptococcal meningitis
- Cerebral malaria
- Viral encephalitis
- Repeat the LP after 3-5 days if fever still present and/or the child's overall condition is not improving.

6.3.2 Meningococcal epidemics

During a confirmed epidemic of meningococcal meningitis:

- For children aged 0–23 months, treatment should be adapted according to the patient's age, and an effort should be made to exclude any other cause of meningitis.

- For children aged ≥ 2–5 years, *Neisseria meningitides* is the most likely pathogen and presumptive treatment is justified. Give ceftriaxone at 100 mg/kg/day IM or IV once daily for 5 days, and for infants aged 0-2 months treat for 7 days.

Or

- Give oily chloramphenicol *(100 mg/kg IM as a single dose up to a maximum of 3 g). If no improvement after 24 h, give a second dose of 100 mg/kg, or change to ceftriaxone as above

* The oily chloramphenicol suspension is thick and may be difficult to push through the needle. If this problem is encountered, the dose can be divided into two and an injection given IM.

6.3.3 Tuberculous meningitis

Tuberculous meningitis may have an acute or chronic presentation, with the duration of presenting symptoms varying from 1 day to 9 months. It may present with cranial nerve deficits, or it may have a more indolent course involving headache, meningismus and altered mental status.

- The initial symptoms are usually nonspecific, including headache, vomiting, photophobia and fever.
- Consider tuberculous meningitis if any of the following is present:
- Fever has persisted for 14 days.
- Fever has persisted for > 7 days and the child has close contact with person diagnosed to have tuberculosis
- A chest X-ray suggests TB.
- The patient is unconscious and remains so despite treatment for bacterial meningitis.
- The patient is known to have HIV infection or is exposed to HIV.
- The CSF has a moderately high white blood cell count (typically 10-500 white cells per ml, mostly lymphocytes), elevated protein (0.8–4 g/l) and low glucose (< 1.5 mmol/l),
- GeneXpert positive
- CSF profile persists despite adequate treatment for bacterial meningitis.
- Occasionally, when the diagnosis is not clear, a trial of treatment for tuberculous meningitis is added to treatment for bacterial meningitis

Treatment

The optimal treatment regimen comprises:

- Four-drug regimen (HRZE) for 2 months, followed by a two-drug regimen (HR) for 10 months, the total duration of treatment being 12 months. Dose (see section 4.7.2)

- Prednisolone 2mg/kg/day divided dose for 4 weeks, reducing the dose over a further 2–3 weeks) should be given in all cases of tuberculous meningitis.
- Children with proven or suspected tuberculous meningitis caused by MDR bacilli can be treated with a fluoroquinolone and other second-line drugs in the context of a well-functioning MDR TB control programme and within an appropriate MDR TB regimen. The decision to treat should be taken by a clinician experienced in managing paediatric TB.

Note: Streptomycin is not advised for children as it may cause otoxicity and nephrotoxicity, and the injections are painful.

Cryptococcal meningitis

- Consider cryptococcal meningitis in older children known or suspected to be HIV-positive with immunosuppression. Children will present with meningitis with altered mental status.
- Perform a lumbar puncture. The opening pressure may be elevated, but CSF cell count, glucose and protein may be virtually normal.
- Analyze CSF with India ink preparation, or, if available, do a rapid CSF Cryptococcal antigen latex agglutination test.

Treatment: A combination of amphotericin and fluconazole (section 8.4.4)

Supportive care

- Examine all children with convulsions for hyperpyrexia and hypoglycaemia. Treat the hypoglycemia. Control high fever (≥ 39 ° C) with paracetamol.
- In an unconscious child:

- Maintain a clear airway.
- Nurse the child on the side to avoid aspiration of fluids.
- Turn the patient every 2 hours.
- Do not allow the child to lie in a wet bed.
- Pay attention to pressure points.

Oxygen treatment

- Give oxygen if the child has convulsions or associated severe pneumonia with hypoxia (<90% saturation), cyanosis, signs of respiratory distress

Fluid and nutritional management

- Give two third of the daily fluid requirement. Monitor IV fluids very carefully and examine frequently for signs of fluid overload. Fluid restriction is not appropriate in the presence of systemic hypotension because reduced blood pressure may result in reduced cerebral perfusion and CNS ischemia.

- Give due attention to acute nutritional support and nutritional rehabilitation. Feed the child as soon as it is safe. Breastfeed every 3 hours, if possible, or give milk feeds as tolerated. If there is a risk of aspiration, give fluid diet through nasogastric tube. Continue to monitor the blood glucose level and treat accordingly.

Monitoring

- Monitor vital signs, the child's state of consciousness, pupils' size, respiratory pattern and rate, every 2 hour during the first 24 h then after 4-6 hrs depending on the condition of the child, input and output and weight daily.

- On discharge, assess all children for neurological problems, especially hearing loss. Measure and record the head circumference of infants. If there is neurological damage, refer the child to neurologist and consider physiotherapy.

Complications

- Acute complication
- Convulsions
- Hypoglycaemia
- Hyponatremia
- Shock
- Subdural effusion

Long term complications

- Sensory hearing loss
- Motor deficit
- Developmental delay
- Epilepsy

Follow-up

- Sensorineural deafness is common after meningitis. Arrange a hearing assessment on all children one month after discharge from hospital.

Public health measures

- In meningococcal meningitis epidemics, advise families of the possibility of secondary cases within the household so that they report for treatment promptly.
- Give chemoprophylaxis for close household contacts with Ciprofloxacin for the index child and close household contacts on discharge.
- A case of meningococcal meningitis must be reported to local authorities.

6.4 Measles

Measles is a highly contagious viral disease with serious complications) and high mortality. It is rare in infants under 3 months of age.

Diagnosis

Diagnose measles if the child has:

- Fever
- A generalized maculopapular rash; and
- One of the following: cough, runny nose, or red eyes.
- In children with HIV infection, these signs may not be present and the diagnosis of measles may be difficult.

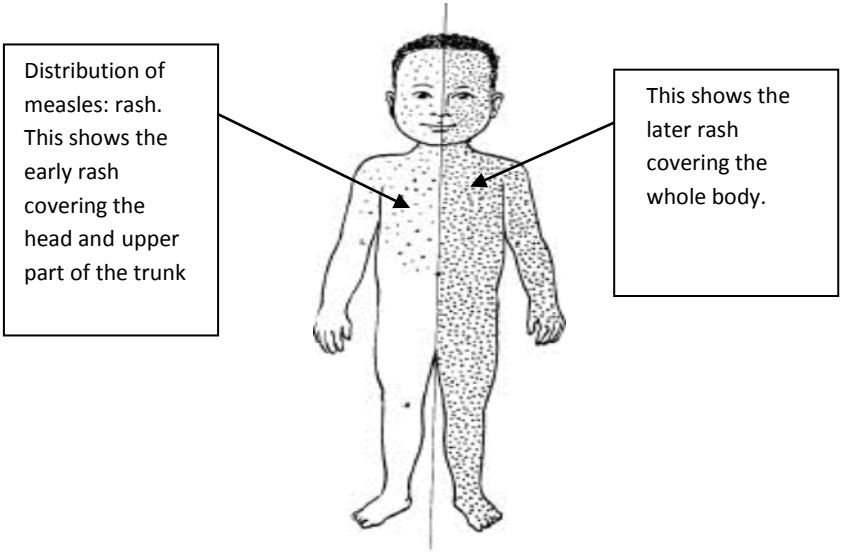

Distribution of measles: rash. This shows the early rash covering the head and upper part of the trunk
This shows the later rash covering the whole body.

Figure 6.3: Distribution of measles rash



Figure 6.4 Corneal clouding—sign of xerophthalamia in vitamin A deficient child shown in comparison to the normal eye (right side)

6.4.1 Severe complicated measles

Diagnosis

In a child with evidence of measles any one of the following symptoms and signs indicate the presence of severe complicated measles:

- Inability to drink or breastfeed vomits everything
- Convulsions
- On examination, look for signs of complications such as lethargy or unconsciousness
- Corneal clouding
- Deep or extensive mouth ulcers.
- Pneumonia
- Dehydration
- Stridor due to measles croup
- Severe malnutrition
- Bloody diarrhoea

Treatment

Children with severe complicated measles require treatment in hospital.

- Vitamin A therapy: Give oral vitamin A to all children with measles unless the child has already had adequate vitamin A treatment for this illness as an out patient. Give oral vitamin A 50,000 IU (for a child aged <6 months), 100,000 IU (6–11 months) or 200,000 IU (12 months up to 5 years) for 2 days.

- If the child shows any eye signs of vitamin A deficiency or is severely malnourished, a third dose must be given 2–4 weeks after the second dose on follow up.

Supportive care

Fever

- If the temperature is ≥ 39 ° C give paracetamol.

Nutritional support (chapter 10)

- Assess the nutritional status
- Encourage continued breast feeding and /or frequent small feeds
- Check for mouth ulcers and treat

Complications

Follow the guidelines given in other sections of this manual for the management of the following complications:

- Pneumonia
- Otitis media
- Diarrhoea
- Measles croup
- Acute malnutrition
- Tuberculosis

Eye problems: Conjunctivitis and corneal and retinal damage may occur due to infection, vitamin A deficiency, or harmful local remedies. In addition to giving vitamin A), treat any infection that is present. If there is a clear watery discharge, no treatment is needed. If there is pusy discharge, clean the eyes using cotton wool boiled in water, or a clean cloth dipped in clean water. Apply tetracycline eye ointment, 3 times a day for 7 days. Never use steroid ointment. Use a protective eye pad to prevent other infections. If there is no improvement, refer to an eye specialist.

Mouth ulcers: If the child is able to drink and eat, clean the mouth with clean, salted water (a pinch of salt in a cup of water) at least 4 times a day.

- Apply 0.25% gentian violet to the sores in the mouth after cleaning.

- If the mouth ulcers are severe and/or smelly, give IM/IV benzyl penicillin (50,000 units/kg every 6 hours) and oral metronidazole (7.5 mg/kg 3 times a day) for 5 days.

- If the mouth sores result in decreased intake of food or fluids, the child may require feeding via a nasogastric tube.

Neurological complications: Convulsions, excessive sleepiness, drowsiness or coma may be a symptom of encephalitis or severe dehydration.

Severe acute malnutrition (Chapter 7)

Monitoring
Take the child's vital signs twice a day and check for the presence of the above complications.

Follow-up
Recovery following acute measles is often delayed for many weeks and even months, especially in children who are malnourished. Arrange for the child to receive the third dose of vitamin A before discharge, if this has not already been given.

Public health measures
If possible, isolate children admitted to hospital with measles for at least 4 days after the onset of the rash. Ideally, they should be kept in a separate ward from other children. In malnourished and immunocompromised children, the isolation should be continued throughout the duration of the illness.

When there are measles cases in the hospital, immunize all other children above the age of 6 months (including those seen in outpatients, children admitted in the week following a measles case, and HIV-positive children). If infants aged 6–9 months receive measles vaccine, it is essential for the second dose to be given as soon as possible after 9 months of age.

6.4.2 Non-severe measles

Diagnosis

Diagnose non-severe measles in a child whose mother clearly reports that the child has had a measles rash, or if the child has:

- Fever
- A generalized rash; and
- One of the following—cough, runny nose or red eyes; but
- None of the features of severe measles

Treatment

Treat as an outpatient.

Vitamin A therapy: Check whether the child has already been given adequate vitamin A for this illness. If not, give 50,000 IU (if aged <6 months), 100,000 IU (6–11 months) or 200,000 IU (12 months to 5 years) for 2 days.

Supportive care

Fever: If the child's temperature is ≥ 39 °C give paracetamol.

Nutritional support: Assess the nutritional status by measuring the mid upper arm circumference. If malnourished, treatment has to be given (see chapter 7). Encourage mother to continue breast feeding, give frequent small meals depending the age of the child. Check for mouth ulcer and treat as above.

Eye and mouth care

Follow-up

Ask the mother to return with the child in two days.

6.5 Septicaemia

Consider septicaemia in a child with acute fever who is severely ill, when no cause can be found after a careful thorough physical examination. Usually

child presents with fever, inability to drink or breast feed, lethargy, vomiting of everything, convulsion.

It can occur as a complication of meningitis, pneumonia, UTI etc.

The common causative agents include *Streptococcus*, *Haemophilus influenza* and in children with severe malnutrition enteric*Gram-negative bacilli-Escherichia coli* and *Klebsiella* are the common causative agents. Wherever meningococcal disease is common, presence of petechiae or purpura (haemorrhagic skin lesions) indicates meningococcal septicaemia. In malarious area non-typhoidal Salmonella is a common cause of septicemia.

Diagnosis

History: Fever, inability to drink or breast feed, lethargy, vomits everything, convulsion.

Physical examination: fever with no evidence of obvious local infection is usual manifestation. The presence of fast, weak pulse volume, delayed capillary refill, hypotension, altered mental status and presence of purpura indicates severe disease with septic shock.

Investigation:

- The investigations will depend on presentation but may include:
- Blood film : Hemoparasite (malaria , Relapsing fever)
- CSF analysis to exclude meningitis
- Full blood count
- Urinalysis (including urine culture)
- Blood culture
- Chest X-rays.

Treatment

I. Antibiotic:

- Give ampicillin (50 mg/kg IV 6-hourly) plus gentamicin (7.5 mg/kg IM once per day) or,
- Alternatively Ceftriaxone (80 mg/kg IV, once daily over 30–60 minutes) for 7-10 days.
- If Staphylococcus infection strongly suspected give Cloxacillin (50 mg/kg 6 hourly) plus gentamicin (7.5 mg/kg once per day).

*****Specimen for culture has to be taken before antibiotic administration as soon as possible

In child with septic shock:

- Administer oxygen
- Secure IV line and treat shock: fluid administration with Ringer Lactate or Normal Saline 20 ml/kg fast and if no response repeat the dose up to 60ml/kg
- Blood transfusion with 20 ml/kg fresh whole blood or 10 ml /kg packed cells if the patient not responding for fluid administration
- If shock is refractory start with adrenalin or dopamine (refer standard text book of paediatrics for dosage).

Complications

Common complications of septicaemia include convulsions, confusion or coma, dehydration, shock, cardiac failure, disseminated intravascular coagulation (with bleeding episodes), pneumonia, anaemia, renal failure, etc. Septic shock with multi organ failure is common cause of death.

Monitoring

A child with septic shock needs continuous monitoring of vital signs and for response of treatment and presence of complications.

Child without septic shock has to be checked/assessed by the nurse and physician

6.6 Typhoid fever

Consider typhoid fever if a child presents with fever persisted for seven or more days, plus any of the following: diarrhea or constipation, vomiting, abdominal pain, headache, cough, after malaria has been excluded.

Diagnosis

On examination, key diagnostic features of typhoid are:

- Fever with no obvious focus of infection
- No stiff neck or other specific signs of meningitis or ruled out by investigation (note: children with typhoid can occasionally have a stiff neck)
- Signs of systemic upset, e.g. inability to drink or breastfeed, convulsions, lethargy, disorientation/confusion, or vomiting everything
- Rose spots on the abdominal wall in light-skinned children
- Hepato-splenomegaly, tense and distended abdomen.

Typhoid fever can present atypically in young infants as an acute febrile illness with shock and hypothermia. In areas where typhus is common, it may be very difficult to distinguish between typhoid fever and typhus by clinical examination alone (see standard paediatrics textbook for diagnosis of typhus).

Lab test

- Blood culture and sensitivity test,
- WBC and differential
- Widal test – rising titer

Treatment

- Ciprofloxacin 15mg /kg twice daily for 7-10 days.
- Ceftriaxone: (50 mg/kg IM, once daily) for 7days
- In admitted cases, IV drugs must be instituted.

Supportive care

- If the child has high fever ≥ 39 ° C), give paracetamol.
- Monitor haemoglobin or haematocrit levels and consider transfusion when there is severe anemia.

Monitoring

The child should be checked for vital signs and complication by nurses and physicians

Complications

- CNS: convulsions, confusion or coma
- Hematologic: Anemia,
- Gastrointestinal: acute gastrointestinal perforation with haemorrhage and peritonitis can occur, usually presenting with severe abdominal pain, vomiting, and abdominal tenderness, severe pallor and shock. Abdominal examination may show an abdominal mass due to abscess formation, an enlarged liver and/or spleen. If there is a sign of gastrointestinal perforation, open an IV line and give appropriate fluid and insert nasogastric tube, consult surgeon as soon as possible.
- Miscellaneous: cardiac failure, pneumonia, osteomyelitis and in young infants, shock and hypothermia can occur.

6.7 Ear infections

6.7.1 Mastoiditis

Mastoiditis is a bacterial infection of the mastoid bone behind the ear. Without treatment it can lead to meningitis and brain abscess.

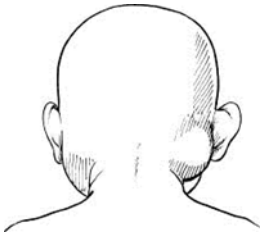


Figure 6.5 Mastoiditis—a tender swelling behind the ear which pushes the ear forward

Diagnosis

Key diagnostic features are:

- High fever
- Tender swelling behind the ear

Treatment (WHO)

- Give IM or IV cloxacillin 50mg/kg every 6 h or ceftriaxone 50 mg /kg for total of ten days
- If there is no response to treatment within 48 hours or the child's condition deteriorates, consult surgical specialist to consider incision and drainage of mastoid abscesses or mastoidectomy.
- If there are signs of meningitis, give antibiotic treatment as in bacterial meningitis
- If brain abscess suspected start antibiotic and consult surgical specialist immediately

Supportive care

- If high fever (≥ 39 ° C) is causing distress or discomfort to the child, give paracetamol.

Monitoring

- The child should be monitored frequently. If the child responds poorly to treatment, consider the possibility of meningitis or brain abscess

6.7.2 Acute Otitis Media

Diagnosis

- Opaque, or perforated tympanic membrane with discharge

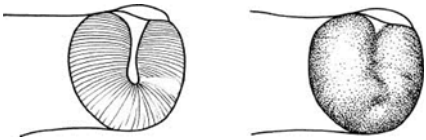


Figure 6.6 Acute otitis media—bulging red eardrum (compared to normal appearance of eardrum on left)

Treatment

- Treat the child as an outpatient.
- Give oral antibiotics in one of the following regimens:
- First choice: Oral amoxicillin at 40 mg/kg twice a day for at least 5 days
- If sensitivity for co-trimoxazole is known, give co-trimoxazole (trimethoprim 4mg/kg and sulfamethaoxazole 20 mg/kg twice daily for five days).

- If pus is draining from the ear, show the mother how to wick the ear three times daily until there is no more pus.
- Tell the mother not to place anything in the ear between treatments. Do not allow the child to go swimming or get water in the ear.
- If the child has ear pain or high fever (≥39 °c), give paracetamol

Follow up

Ask the mother to return after five days.

If pain and or discharge persist, treat for five more days with the same antibiotic and continue wicking and follow up in five days. If no improvement refer to ENT.



Figure 6.7: wicking the child's ear dry in chronic otitis media

6.7.3 Chronic Otitis Media

If pus has been draining from the ear for 2 weeks or longer, the child has a chronic ear infection.

Diagnosis

This is based on a history of pus draining from the ear for more than 2 weeks. On examination, confirm chronic otitis media) by otoscopy.

Treatment

- Keep the ear dry by wicking
- Instill topical antibiotic (with or without steroids) once daily for 2 weeks.

- Drops containing quinolones (norfloxacin, ciprofloxacin) are more effective than other antibiotic drops and can be applied for 14 days.

Follow-up

- Ask the mother to return after 5 days.
- If the ear discharge persists, check that the mother is continuing to wick the ear.
- If the ear discharge persists, encourage the mother to continue to wick the ear dry and refer for ENT evaluation.

6.8 Urinary tract infection

Urinary tract infection (UTI) is common in boys during infancy because of posterior urethral valve. Beyond infancy females are more affected. As bacterial culture is usually not available in developing countries, the diagnosis is usually based on clinical signs and urine microscopy.

Diagnosis

- In infants and young children UTI presents as nonspecific symptoms
- Fever >38 degree for at least 24 hrs without obvious cause
- Vomiting or poor feeding
- Irritability, lethargy, failure to thrive
- Abdominal pain
- Jaundice (neonate)
- In older children, specific symptoms such as increased frequency, pain during micturition, abdominal (loin) pain may be observed

Investigation

- Examine a clean , fresh, uncentrifuged specimen of urine under microscopy

- WBC > 5 white cells/HPF; dipstick positive result for leukocyte; nitrate positive
- Microscopy : bacteria
- Culture: obtain a "clean catch" urine sample for culture. In sick infants, supra-pubic aspiration or catheterization is required. And colony count > 10^6.

Treatment

Outpatient treatment: Give oral Co-trimoxazole (4 mg trimethoprim/20 mg sulfamethaoxazole per kg every 12 hours) for 7-10 days. Alternatives include ampicillin, amoxicillin and cephalexin.

Admission and parenteral treatment indicated if:

- Infant
- Systemic upset such as high grade fever, vomiting, inability to feed or drink
- Signs of pyelonephritis (loin pain or tenderness)
- If there is a poor response to the first-line antibiotic or the child's condition deteriorates, admit the patient and give gentamicin (7.5 mg/kg IM once daily) plus ampicillin (50 mg/kg IM/IV every 6 hours) or a parenteral cephalosporin for seven day.
- Treat young infants aged < 2 months with gentamicin at 7.5 mg/kg IM or IV once daily until the fever has subsided; then review, look for signs of systemic infection, and, if absent, continue with oral treatment, as described above.

Supportive care

- The child should be encouraged to drink or breastfeed regularly in order to maintain a good fluid intake, which will assist in clearing the infection and prevent dehydration.
- Regular voiding habit and complete emptying of bladder has to be encouraged.

Follow-up

All children less than five years of age with febrile UTI have to be investigated with US of the kidney and bladder, and voiding cystourethrography (VCUG).

6.9 Relapsing Fever

Relapsing fever is a louse-borne disease that is caused by the spirochaetes, Borrelia recurrentis. The disease is common among the homeless and in those living in overcrowded living conditions.

Diagnosis

- Fever of relapsing pattern
- Petechial rash / skin haemorrhages
- Jaundice
- Tender enlarged liver and spleen

Investigation: Positive blood smear for Borrelia

Treatment

Delousing

- Remove all clothing and wash the body with the antiseptic /soap.
- Shave the hair.

II. Drug Treatment

- Secure IV line with ringer lactate
- Control the temperature with paracetamol

- Administer Procaine penicillin: 50,000/kg max 400,000 units IM stat.
- For newborns Crystalline penicillin 10,000 IU/Kg IM stat
- Continuous monitoring of vital sign temperature, pulse RR, blood pressure in the first three hours is mandatory
- Check blood film after 12 hours of treatment. If negative, chloramphenicol 25mg/kg every 6 h for 3 days

Complications

- Jarisch-Herxheimer reaction and is believed to be due to a rapid clearance of the spirochetes and usually develops 60-90 minutes after the antibiotic is given.
- In the initial phase the heart rate, respiratory rate and temperature rise quickly to higher level and patient becomes distressed and anxious followed by vasodilatation and progressive fall of blood pressure.
- In order to mitigate this complication administer the ringer lactate fast and control the fever with rectal/IV paracetamol. Respiratory and cardiovascular support needed as indicated.

6.10 Acute Tonsillopharyngitis

Common upper respiratory tract infection caused mainly by viruses and sometimes by bacteria commonly Group A beta hemolytic streptococcus.

Diagnosis: mainly clinical:

- Fever, vomiting , difficulty of swallowing
- Hyperemic enlarged tonsils with follicle or exudates
- Tender enlarged anterior cervical lymph nodes

Treatment

- Benzathine penicillin 600,000IU IM stat for children <27 kgs of weight; 1.2 million IU for child > 27 kg OR
- Amoxicillin 50 mg/Kg/day po in three divided doses for 10 days
- For patients allergic to penicillin , Erythromycin 40 mg/kg/day in four divided doses for 10 days
- Follow up in two days if no improvement

6.11 Primary herpetic gingivostomatiitis

It is the most common cause of stomatitis in children 1–3 yr of age.

Clinical manifestation

- Abrupt onset of fever as high as 40°c and irritability 1-2 days prior to the oral lesion.
- Pain in the mouth, salivation, fetor oris, refusal to eat
- Small (2-10mm in diameter) multiple ulcers on the buccal mucosa, tongue and in some cases the tonsillar regions are involved and may appear exudative, mimiking acute tonsillitis of bacterial origin.
- Submandibular lymphadenitis is common.
- Acute phase lasts 4–9 days and is self-limited

Diagnosis is mainly clinical.

Treatment

- Oral acyclovir (15mg/kg/dose five times a day with a maximum dose of 1g/24 hr for 7 days) started within 72 hr of onset of lesions.

- Supportive care: mouth washes with saline, GV (0.25%) paint of the mucosal lesion, ice-cold fluids, or semisolids are often accepted when other food is refused.

6.12 Septic Arthritis and Acute Osteomyelitis

Acute infection of the bone or joint is usually caused by spread of bacteria through the blood. However some bone or joint infections results from an adjacent focus of infection or from a penetrating injury. Occasionally several bones and joints might be involved. The commonest causative agents for pyogenic infection depend on the age of the patient.

In children older than three years, *Staphylococcus aureus is the commonest agent.* In younger children *H. influenzae*type b, *Streptococcus pneumoniae,* or *S. pyogenes (*group A *strept) are responsible. Salmonella* is a common cause in young children living in malarious area and children with sickle-cell disease.

Diagnosis

- History and physical examination:
- Fever
- Refusal to use the affected limb or joint or bear weight on the affected leg
- Swelling over the bone and tenderness (osteomyelitis)
- Hot, swollen, tender joint or joints with reduced range of movement (septic arthritis)

Laboratory investigations

- Leukocytosis
- Raised ESR

- X-rays are not helpful in diagnosis of acute osteomyelitis in the early stages of the disease. After 2-3 weeks elevated periosteum may be visible.
- In septic arthritis soft tissue swelling widening of joint space may be visible
- Arthrocentesis and synovial fluid analysis: aspiration of fluid from affected joint space: under strictly aseptic condition after proper immobilization of the joint and application of adequate local analgesics using 1% lidocaine, aspirate using needle large enough to aspirate thick fluid/pus. Send the synovial fluid for analysis: cell count, gram stain and culture (section 9.5.3).

Treatment

- Antibiotic: choice depends on the age of the patient.
- Child <3 yrs. : ceftriaxone IV for four to six weeks depending on the response of the patient
- Child > 3 yrs : Cloxacillin 50mg/kg every 6 hrs if not available, give chloramphenicol
- Clindamycin or second- or third-generation cephalosporin may be given.
- Once the child's temperature returns to normal and ESR is decreasing, change to equivalent oral treatment with the same antibiotics, and continue for a total of 3 weeks for septic arthritis and 5 weeks for osteomyelitis.
- **Septic Arthritis:** Pus has to be removed by aspirating the joint. Open surgical drainage is indicated in case involving shoulder and hip joints (Section 9.5.3)

Supportive care

- The affected limb or joint should be rested and weight bearing not allowed until the pain subsides.
- Pain management according to severity (chapter 10)
- Control fever with paracetamol

Chronic osteomyelitis

- The child usually appears less ill and the clinical signs are less marked local signs and may not have fever. Usually may have chronic draining sinuses over the affected bone.
- X- Ray may show elevated periosteum, sequestrum (collection of dead bone)
- Treatment: surgical removal of dead bone (sequestrectomy) and IV antibiotic for one week and then change to PO for 4-6 weeks depending on ESR
- Consider tuberculous osteomyelitis when the illness is slow onset of swelling and chronic course, discharging sinuses and not responding for above treatment or if the patient has other signs of tuberculosis.
- Treatment is according to national TB control programme guideline (section 4.7.2) and surgical treatment is not indicated.

6.13 Rheumatic fever

Rheumatic fever is non-suppurative complications of Group A streptococcal pharyngitis due to a delayed immune response affecting joints, central nervous system, integumentary system, and heart. The symptoms usually appears two to four weeks after the

throat infection with beta hemolytic streptococcus .The diagnosis of acute rheumatic fever is mainly clinical based on modified Jones criteria.

- Two major or one major and two minor manifestations plus evidence of previous group A streptococcal infection is diagnostic to rheumatic fever.

Major manifestations are:

- Carditis
- Polyarthritis
- Erythema marginatum
- Subcutaneous nodules
- Chorea.

Minor criteria

- Fever
- Arthralgia in absence of polyarthritis
- Elevated acute phase reactants (erythrocyte sedimentation rate or leukocyte count)
- PR prolongation, in absence of carditis
- **Recent evidence of streptococcal infection**
- Elevated or rising anti-streptolysin-O or other streptococcal antibody
- Rapid antigen test for group A streptococci
- A positive throat culture for streptococci
- Recent scarlet fever

Table 6.9 WHO criteria for the diagnosis of rheumatic fever and rheumatic heart disease

Diagnostic categories	Criteria
Primary episode of RF	Two major or one major and two minor manifestations plus evidence of a preceding group A streptococcal infection
Recurrent attack of RF in a patient without established rheumatic heart disease	Two major or one major and two minor manifestations plus evidence of preceding group A streptococcal infection
Recurrent attack of RF in a patient with established rheumatic heart disease	Preceding group A streptococcal infection
Rheumatic chorea Insidious onset rheumatic carditis.	Evidence of Group A streptococcal infection not required
Chronic valve lesions of RHD (patients Presenting for the first time with pure mitral stenosis or mixed mitral valve disease. And/or aortic valve disease	Diagnosed as having rheumatic heart disease

Treatment

I. Eradication of beta hemolytic streptococcal infection

Benzathine penicillin 300,000-1.2 million IU stat dose depending on the age

II. Suppression of inflammatory response

- Rheumatic Fever without carditis: Aspirin 100 mg/kg/day divided in four doses for two weeks and decrease to 75 mg /kg divided doses for two more weeks
- Rheumatic fever with carditis: Prednisolone 2mg/kg in four divided doses for two weeks
- Tapper the prednisolone in the next two weeks
- While tapering, add Aspirin 75 mg /kg in four divided doses for the next four weeks

III. Treatment of heart failure

- Bed rest
- Salt free diet
- Oxygen
- Diuretics: furosemide 1-2 mg/kg divided in two doses and spironolactone 3mg/kg/day once daily. If not available add potassium chloride 1-2mg/kg PO daily
- Consult cardiologist or refer the child for better evaluation and management

Complications

- Recurrence of rheumatic fever
- Chronic rheumatic valvular heart disease
- Infective endocarditis
- Arrhythmia

- Stroke (Thromboembolic)
- Heart failure

Follow up

- Secondary prophylaxis with Benzathine penicillin 300,000-1.2 mu every 4 weeks im to prevent recurrence
- Review every 1-3 months at cardiac follow up clinic depending on clinical condition of the patient
- Referral for possible surgical treatment after cardiology consultation in case of chronic valvular heart disease

Prevention

Primary prophylaxis: Treatment of bacterial tonsilopharyngitis

Secondary prophylaxis: Monthly Benzathine penicillin for five years for those with RF without carditis and for life for those with carditis.

In children with chronic valvular heart disease administer antibiotics one hour before dental, gastrointestinal, and genitourinary procedures to prevent bacterial endocarditis.

6.14 Dengue

Dengue is caused by an arbovirus transmitted by Aedes mosquitoes

Diagnosis

- Suspect dengue fever in an area of risk for dengue. If the child has:
- Fever lasting > 2 days
- Headache, pain behind the eyes
- Joint and muscle pain
- Abdominal pain, vomiting
- Rash may occur but is not always present.

- It can be difficult to distinguish dengue from other common childhood infections.

Treatment

Most children can be managed at home, provided the parents have good access to a hospital.

Counsel the parents to bring the child back for daily follow-up and to return immediately if any of the following occur:

- Severe abdominal pain, persistent vomiting,
- Cold, clammy extremities,
- lethargy or restlessness,
- Bleeding, e.g. black stools or coffee-ground vomit.
- Encourage oral fluid intake with clean water or ORS solution to replace losses during fever and vomiting.
- Give paracetamol for high fever if the child is uncomfortable. **Do not give aspirin or NSAIDs such as ibuprofen, as these drugs may aggravate bleeding**.
- Follow-up the child daily until the temperature is normal.
- Check the hematocrit daily if possible.
- Check for signs of severe disease.
- **Admit any child with signs of severe disease**
- Mucosal or severe skin bleeding
- Shock, altered mental status
- Convulsions
- Jaundice
- Rapid or marked rise of hematocrit

6.14.1 Severe dengue

Severe dengue is defined by one or more of the following:

- Suspect severe dengue in an area of risk for dengue if the child has fever lasting > 2 days, and any of the following features:
- Evidence of plasma leakage
- High or progressively rising hematocrit
- Pleural effusions or ascites
- Circulatory compromise or shock
- Cold, clammy extremities
- Prolonged capillary refill time (> 3 s)
- Weak pulse (fast pulse may be absent even with significant volume depletion)
- Narrow pulse pressure < 20mmHg
- Spontaneous bleeding
- From the nose or gums
- Black stools or coffee-ground vomit
- Skin bruising or extensive petaechiae
- Altered level of consciousness
- Lethargy or restlessness
- Coma
- Convulsions
- Severe gastrointestinal involvement
- Persistent vomiting
- Increasing abdominal pain with tenderness in the right upper quadrant
- Jaundice

Diagnosis

Clinical with high grade fever and any of the above mentioned features.

Treatment

Admit all patients with severe dengue.

Fluid management: patients without shock (pulse pressure > 20 mm Hg)

- Give IV fluids for repeated vomiting or a high or rapidly rising HCT. Give only isotonic solutions such as normal saline and Ringer's lactate or 5% glucose in Ringer's lactate.
- Start with 6 ml/kg per h for 2 h, and then reduce to 2–3 ml/kg per h as soon as possible, depending on the clinical response.
- Give the minimum volume required to maintain good perfusion and urine output. IV fluids are usually needed only for 24–48 h, as the capillary leak resolves spontaneously after that time.

Fluid management: patients in shock (pulse pressure ≤20 mm Hg)

- Treat as an emergency. Give 10–20 ml/kg of an isotonic crystalloid solution such as Ringer's lactate or normal saline over 1 h. If the child responds (capillary refill and peripheral perfusion start to improve, pulse pressure widens), reduce to 10 ml/kg for 1 h and then gradually to 2–3 ml/kg per h over the next 6–8 h.

If the child does not respond (continuing signs of shock), give a further 20 ml/kg of the crystalloid over 1 h, or consider giving 10 ml/kg of a colloid solution if available such as 6% dextran (molecular mass, 200,000) over 1 h. Revert to the crystalloid schedule described above as soon as possible. Frther small boluses of extra fluid (5–10 ml/kg over 1 h) may be required during the next 24-48 h.

- Decide on fluid treatment on the basis of clinical response.
- Review vital signs hourly (pulse and blood pressure)

- Hematocrit
- Monitor urine output.

A rising Hematocrit with unstable vital signs (particularly narrowing of the pulse pressure) indicates the need for a further bolus of fluid, but extra fluid is not needed if the vital signs are stable, even if the hematocrit is very high (50–55%).

The Hematocrit is likely to start falling within the next 24 h as the absorptive phase of the disease begins.

In most cases, IV fluids can be stopped after 36–48 h. Remember that too much fluid can result in death due to fluid overload.

Treatment of haemorrhagic complications

- **Minor bleeding*:*** Manifested as mucosal bleeding due to low platelet count. It is usually self-limiting and resolve within two weeks.

- In children with low platelet (less than 20,000/mm^3) order strict bed rest, protect from trauma, and avoid IM injections. Platelet concentrate not indicated for thrombocytopenia without bleeding.

- **Major bleeding**: gastrointestinal tract bleeding with tarry (black) stool is the usual manifestation.

- Consider the possibility of GI bleeding in child with shock who fail to improve clinically with fluid treatment particularly if appears very pale, hematocrit is falling or abdomen become distended and tender.

- Transfusion rarely necessary; if indicated give 5-10ml/kg fresh whole blood or 10 ml/kg packed cells over 2-4 hrs. Repeat if there is response and significant bleeding is confirmed.

Treatment of fluid overload

Fluid overload is an important complication of treatment for shock. It can develop due to:

- Excess or too rapid IV fluids
- Incorrect use of hypotonic rather than isotonic crystalloid solutions
- Continuation of IV fluids for too long (once plasma leakage has resolved)
- Use of large volumes of IV fluid in children with severe capillary leakage
    - Early signs: peri-orbital or soft tissue oedema, fast breathing, chest indrawing, large pleural effusions, ascites
    - Late signs: cyanosis, pulmonary oedema, irreversible shock (often a combination of ongoing hypovolaemia and cardiac failure)

The management of fluid overload varies depending on whether the child is in or out of shock:

- Children who remain in shock and show signs of severe fluid overload:
- Repeated small boluses of a colloid solution may help with inotropic agents to support the circulation (see standard textbooks of paediatrics). Avoid diuretics, as they will cause further intravascular fluid depletion.
- Aspiration of large pleural effusions or ascites may be needed to relieve respiratory symptoms, but there is the risk of bleeding during the procedure.

- Continuous positive pressure ventilation before pulmonary oedema develops if it is available
- If **shock has resolved** but the child has fast or difficult breathing and large effusions, give oral or IV furosemide at 1 mg/kg once or twice a day for 24 h and oxygen therapy.
- If shock has resolved and the child is stable, stop IV fluids and keep the child on strict bed rest for 24–48 h. Excess fluid will be reabsorbed and lost through urinary diuresis.

Supportive care

- Treat high fever with paracetamol if the child is uncomfortable. Do not give aspirin or NSAIDs such as ibuprofen, as they aggravate the bleeding.
- Do not give steroids.
- Treat Convulsions (Chart 9)
- If the child is unconscious, follow the guidelines in section 1.5.3.
- Children in shock or with respiratory distress should receive oxygen, if possible with nasal continuous positive airway pressure (see above).
- Treat Hypoglycaemia
- If the child has severe hepatic involvement, see standard paediatric textbook for guidelines.

Monitoring

Child with severe disease

Monitor the vital signs continuously if monitor available, otherwise hourly particularly the pulse pressure until the patient is stable.

- Monitor input and output hourly

- Check the Hematocrit four times a day.
- A doctor should review the patient at least four times a day and prescribe IV fluids for a maximum of 6 h at a time.

Child without shock

- A nurse should check the child's vital signs (temperature, pulse and blood pressure) at least four times a day
- Hematocrit once daily and platelet count daily
- A doctor should review the patient at least once daily.
- Keep a detailed record of all fluid intake and output.

CHAPTER 7 - SEVERE ACUTE MALNUTRITION

Severe malnutrition is one of the most common causes of morbidity and mortality among children under the age of 5 years worldwide. With appropriate case management in hospitals and follow-up care, the lives of many children can be saved, and the facility case fatality rates can be reduced significantly, a mortality rate has been reduced from over 30% to less than 5%.

Severe malnutrition is both a medical and a social disorder. Successful management of the severely malnourished patients requires that both medical and social problems be recognized and corrected.

7.1 Diagnosis

Key diagnostic features of severe acute malnutrition are:

- Infants less than six months:
  - Weight –for- Length (W/L) less than 70% of NCHS median,
    OR
  - Presence of pitting Oedema of both feet, OR
  - Visible Severe Wasting if it is difficult to determine W/L
- Children 6 months to 5 years:
  - Weight for Height (W/H) or Weight –for- Length (W/L) less than 70 % of NCHS median, OR
  - Presence of pitting Oedema of both feet, OR
  - MUAC<11.5 cm for a child with a length greater than 65 cm if W/L or W/H is difficult to measure

If weight-for-height or weight-for-length cannot be measured, use the clinical signs for visible severe wasting (see Figure below, the child with Mararsmus). A child with visible severe wasting appears very thin and has no fat. There is severe wasting of the shoulders, arms, buttocks and thighs,

with visible rib outlines.

***Note**: No distinction has been made between the clinical conditions of kwashiorkor, marasmus, and marasmic kwashiorkor because the approach to their treatment is similar.*



Figure 7.1 A Child with visible severe wasting



Figure 7.2 B Child with edematous malnutrition

7.2 Initial assessment of the severely malnourished child

Take a history concerning:

- Recent intake of food and fluids
- Usual diet (before the current illness)
- Breastfeeding
- Duration and frequency of diarrhoea and vomiting, if there is recent sunkening of eyes

- Type of diarrhoea (watery/bloody)
- Loss of appetite
- Family circumstances (to understand the child's social background)
- Cough over 2 weeks
- Contact with an adult with tuberculosis
- Recent contact with measles cases
- Known or suspected HIV infection/exposure.

Do physical examination:

- Look general appearance: lethargy, abnormal gaze
- Take vital signs: temperature, respiratory rate, pulse, BP
- Do growth assessment: weight, height/length, HC, weight-for-height/length
- Signs of shock and dehydration (cold hands, slow capillary refill, weak and rapid pulse)
- Conjunctival pallor, sunken eye ball, eye signs of vitamin A deficiency (dry conjunctiva or cornea, Bitot's spots, corneal ulceration, keratomalacia)
- mouth ulcers, oral thrush, signs of local infection(including ear and throat infections)
- Findings suggestive of pneumonia
- Skin changes of kwashiorkor
  - Hypo- or hyperpigmentation
  - Desquamation
  - Ulceration (spreading over limbs, thighs, genitalia, groin, and behind the ears)
  - Exudative lesions (resembling severe burns) often with secondary infection (including Candida)
- Severe palmar pallor,

- Pitting edema of both feet

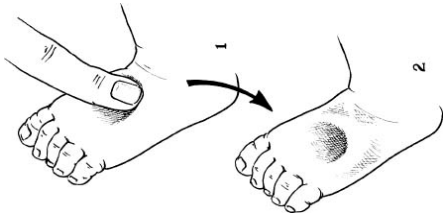


Figure 7.1 A: Pitting edema

- Bitot's spot (conjunctival xerosis)—sign of xerophthalmia in a vitamin A deficient child

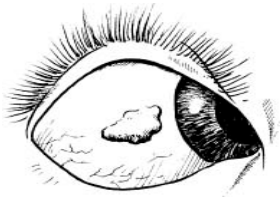


Figure 7.1 B: Bitot's spots

Note: Children with vitamin A deficiency are likely to be photophobic and will keep their eyes closed. It is important to examine the eyes very gently to prevent corneal rupture.

- Do appetite test procedure if the child has no serious medical complications (see section 7.6 for medical complications; Refer Nutrition Guideline for Appetite test procedures)

Investigation

Do the following investigations depending on the patients' condition:
CBC, U/A, urine culture, stool exam, chest X-ray, TSP, blood culture, and HIV test

Table 7.1 Asses and classify an infant age under 6 months for Severe Acute Malnutrition (SAM)

Infants under 6 Months		
Assess	**Classify**	**Action**
• WFL < 70% of median or < -3Z score, OR • Visible severe wasting, OR • Edema of both feet	**Complicated Severe Acute Malnutrition**	**Admit for in-patient management**
• WFL ≥ 70% to < 80% of median, or WFL ≥ -3Z to < -2Z score, AND • No edema of both feet	**Moderate Acute Malnutrition**	Counsel on infant feeding/ care
• WFL ≥ 80% of median or ≥ -2Z score, AND • No edema of both feet	**No Acute Malnutrition**	Congratulate her and Counsel the mother on infant feeding/ care

Table 7.2 Assess and Classify a child age 6 months to 5 years for Severe Acute malnutrition

Children age 6 Months to 5 years		
Assess	**Classify**	**Action to take**
• WFL/H < 70% of median or < -3Z score OR MUAC <11cm OR Edema of both feet (+, ++), **PLUS** ○ Any one of the medical complications (see list below*), or ○ Failed Appetite test OR • +++ Edema, OR • Marasmic Kwashiorkor (WFL/H < 70% with edema, OR MUAC <11cm with edema)	**Complicated Severe Acute Malnutrition**	**Admit for in-patient management**
• WFL/H < 70% of median or < -3Z score OR MUAC <11cm OR • Edema of both feet (+, ++) AND • No medical complication AND pass appetite test	**Uncomplicated Severe Acute Malnutrition**	Manage in OTP using the OTP protocol or manage as in-patient if OTP service is not available
• WFL/H ≥ 70% to < 80% or ≥ -3Z to < -2Z score OR MUAC 11cm to <12cm AND • No edema of both feet	**Moderate Acute Malnutrition**	Refer to supplementary feeding program if available, Counsel on infant and child feeding/care
• If WFL/H ≥ 80% or ≥ -2Z score OR MUAC ≥ 12 cm AND • No edema of both feet	**No acute malnutrition**	Congratulate and Counsel the mother on infant and child feeding/ca

7.3 Admission criteria

List of common medical complications:

1. Unable to breast feed, drink or feed
2. Vomiting everything
3. Convulsions
4. Very Weak, Lethargic or unconscious
5. Hypothermia: axillary temp <35 ^{0}C or rectal < 35.5 ^{0}C
6. Fever ≥ 38.5 ^{0}C
7. Pneumonia/severe pneumonia
8. Shock
9. Dehydration (*watery diarrhea with recent sunken eye balls.*)
10. Dysentery
11. Persistent diarrhoea
12. Hypoglycaemia
13. Severe anemia (*severe palmar pallor*)
14. Jaundice
15. Bleeding Tendencies
16. Dermatosis +++
17. Corneal clouding or ulceration
18. Measles (now or with eye/mouth complications)

Edema grading: bilateral edema below ankles (+); below the knees & the elbows (++); generalized edema involving the upper arms & face (+++).
Dermatosis grading: few discolored or rough patches of skin (+); multiple patches on arms and/or legs (++); flaking skin, raw skin or fissures (openings in the skin) is grade +++ dermatosis.
Measles: If a child has generalized rash with one of the following: cough, runny nose or red eys
Measles with eye or mouth complications: If a child with measles has pus draining from the eye, clouding of cornea or mouth ulcers (deep or extensive ulcers).

All infants less than 6 months with Severe Acute Malnutrition should be admitted for inpatient care of the therapeutic feeding program (TFP).

Children 6 months to 5 years with severe acute malnutrition and any one of the following should be admitted for in-patient care of the TFP:

- Any of the following serious medical complications:
  - Severe vomiting/ intractable vomiting
  - Hypothermia: axillary's temperature <35°C or rectal temperature < 35.5 °C
  - Fever>39°C
  - Number of breaths per minute:
    - 60 resps/ min for under 2 months
    - 50 resps/ minute from 2 to 12 months
    - 40 resps/minute from 1 to 5 years OR
    - Any chest in-drawing
- Extensive skin lesions(+++ dermatosis)/ infection
- Very weak, lethargic, unconscious
- Fitting/convulsions
- Severe dehydration based on history & clinical signs
- Shock or any condition that requires an infusion or NG tube feeding.
- Very pale (severe anaemia): Hgb< 4 g/dl
- Hypoglycemia
- Jaundice
- Bleeding tendencies
- Other general signs the clinician thinks warrants transfer to the in-patent facility for assessment

OR

- Failed appetite test,

OR

- If there is no out patient treatment sites in the place where the child is living

OR

- If the parent chooses to be treated as in-patient despite the advise of the health worker.

7.4 Organization of Care

On admission, the child with severe malnutrition should be separated from infectious children and kept in a warm area (25–30 ° C, with no draughts), and constantly monitored. These patients should be admitted directly to the TFU/SC and not treated in an emergency ward or casualty department for the first 24-48 hours, unless the staff of the emergency ward have had specific training in the management of the complications seen in SAM patients. Treatment should be performed in a dedicated room. Washing should be kept to a minimum, after which the child should be dried immediately.

Facilities and sufficient staff should be available to ensure correct preparation of appropriate feeds, and to carry out regular feeding during the day and night. Accurate weighing machines are needed, and records like the **Therapeutic Treatment In-patient Multi-Chart (Multi-chart)** should be kept of the feeds given and the child's weight so that progress can be monitored.

All children with SAM should be given first feed of F-75 or 50 ml of sugar solution (1 rounded teaspoon of sugar in 3and half tablespoons of water)

orally while waiting for admission.

7.5 Treatment Approach

- Treatment of complications
- Routine medicines
- Dietary Treatment
  - Phase I
  - Transition phase
  - Phase II

In the initial phase, a cautious approach is required because of the child's fragile physiological state.

7.6 Treatment of medical complications

7.6.1 Dehydration

Dehydration tends to be over diagnosed and its severity overestimated in severely malnourished children because it is difficult to estimate hydration status accurately in SAM children using clinical signs alone.

Diagnosis

Diagnosis of dehydration should mainly be based on the history rather than on patient examination alone. Ask the mother if the child has had watery diarrhoea or vomiting, recent change in the child's appearance and recent sunkening of eyes.

Consider the diagnosis of dehydration in non-edematous child if there are:

- Definite history of significant recent fluid loss (diarrhoea looking like water, not just 'loose' stools, appearing with sudden onset in the last hours or days)
- Clear history of a recent change in the child's appearance
- If the eyes are sunken, then the mother must say that the eyes have changed to become sunken since the diarrhea or

vomiting started.

Edematous children are over-hydrated, but they are frequently hypovolemic due to dilation of blood vessels with low cardiac output. If the child with edema has definite watery diarrhoea and is deteriorating clinically, diagnose dehydration.

For the diagnosis of shock in SAM children see section 7.6.2

Treatment

Do not use the IV route for rehydration except in cases of shock. Give special rehydration solution for malnutrition, ReSoMal (Table 7.3).

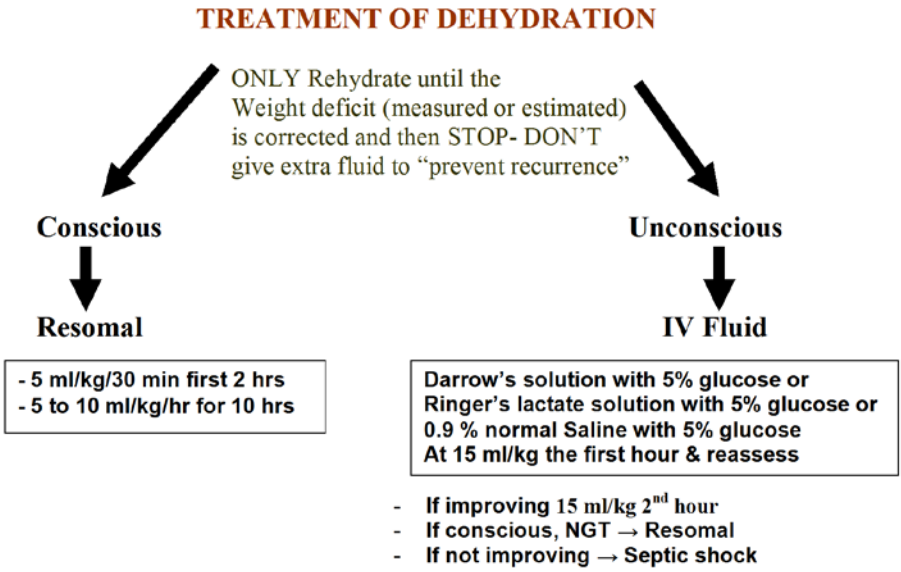
Treat a child with no oedema having signs of dehydration but not in shock as follows:

- Start with 5ml/kg every 30 minutes for the first two hours orally or by naso-gastric tube and then adjust according to the weight changes observed. If there is continued weight loss then increase the rate of administration of ReSoMal by 10ml/kg/hour. If there is no weight gain, Increase the rate of administration of ReSoMal by 5ml/kg/hour. Weigh the child each hour and assess his/her liver size, respiration rate and pulse.
- If there is weight gain and deterioration of the child's condition with the re-hydration therapy, the diagnosis of dehydration was definitely wrong and rehydration should be stopped (a common circumstance). Normally much less ReSoMal is sufficient to restore adequate hydration in malnourished than normally nourished children (e.g. a total of 50ml per kg body weight - 5% body weight).
- After rehydration usually no further treatment is given; however, for malnourished children from 6 to 24 months, 30ml of ReSoMal can be given for each watery stool that is lost.

Treat an oedematous child having signs of dehydration but not in shock. Replace fluid loss at rate of 30 ml of ReSoMal per watery stool. A child who is in shock (both for oedmatous and non-oedematous) should be

treated with intravenous fluids. See the management under shock (section 7.6.2)

Figure 7.2 Summary of treatment of dehydratrion


TREATMENT OF DEHYDRATION
ONLY Rehydrate until the
Weight deficit (measured or estimated)
is corrected and then STOP- DON'T
give extra fluid to "prevent recurrence"
Conscious
Resomal
- 5 ml/kg/30 min first 2 hrs
- 5 to 10 ml/kg/hr for 10 hrs
Unconscious
IV Fluid
Darrow's solution with 5% glucose or
Ringer's lactate solution with 5% glucose or
0.9 % normal Saline with 5% glucose
At 15 ml/kg the first hour & reassess
- If improving 15 ml/kg 2nd hour
- If conscious, NGT → Resomal
- If not improving → Septic shock

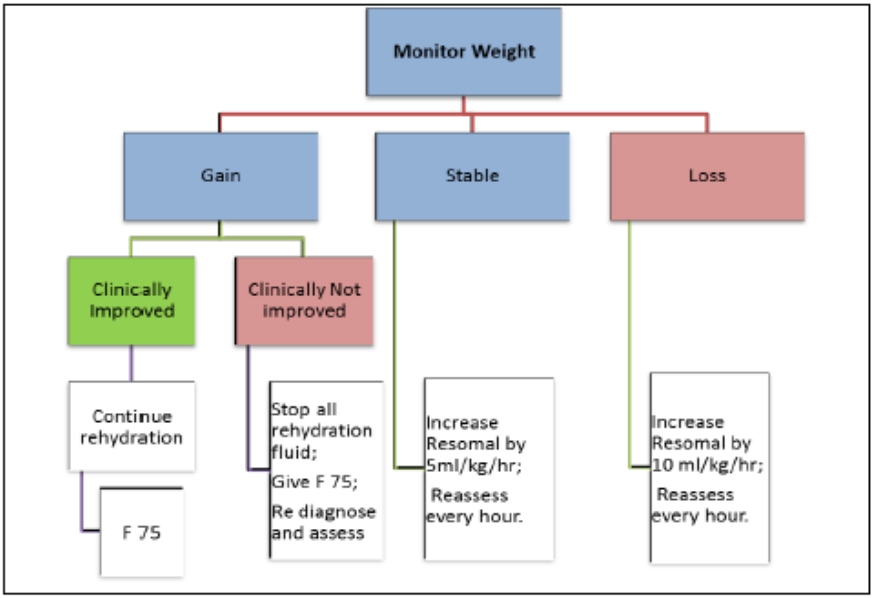


Figure 7.3 Monitoring a child who is on treatment for dehydration

Table 7.3 Recipe for ReSoMal

Ingredient	**Amount**
Water	2 liters
WHO ORS	One 1 liter packet
Sugar	50gms
Electrolyte/Mineral solution*	40ml

*45 ml of KCL solution can be used if electrolyte/mineral solution is not available

7.6.2 Shock

Diagnosis

The severely malnourished child is considered to have shock if he/she is lethargic or unconscious and has cold hands plus either:

- Slow capillary refill (longer than 3 seconds), or
- Weak ,fast or absent radial or femoral pulses and
- Absence of signs of heart failure in an edematous child

Treatment

- Give oxygen
- Keep the child warm

Treat with intravenous fluids :

- Check the starting respiratory and pulse rates and record them on the Multi-chart and also on the shock follow up chart. Also record the starting time.
- Infuse IV fluid at 15ml/kg over 1 hour. Use one of the following solutions, listed in order of preference:
  - Ringer's lactate solution with 5% glucose*
  - 0.9 % normal Saline with 5% glucose* (add 125 ml of 40 % or 100 ml of 50% glucose to 1 litre of 0.9% saline to make this fluid)

*If either of these is used, add sterile potassium chloride (20 mmol/l) if possible.

- Observe the child and check respiratory and pulse rates every 10 minutes (see the shock follow up chart below). Follow the liver size too.
- If the respiratory rate and pulse rate increase and child is gaining weight, stop the IV rehydration and assume septic or cardiogenic shock.

- If respiratory rate and pulse rate are slower after 1 hour, the child is improving. Repeat the same amount of IV fluids for another hour. Continue to check respiratory and pulse rates every 10 minutes.
- After 2 hours of IV fluids, switch to oral or nasogastric rehydration with ReSoMal. Give 5-10 ml/kg ReSoMal in alternate hours with F-75 for up to 10 hours or until fully rehydrated.

Septic (or toxic) shock: Assume that the child has septic shock if a child with shock fails to improve after the first hour of IV fluids. Treat as follows:

- Give maintenance IV fluids (4 ml/kg/hour) while waiting for blood. When blood is available, stop all oral intake and IV fluids, give a diuretic to make room for the blood, and then transfuse whole fresh blood at 10 ml/kg slowly over 3 hours. If there are signs of heart failure, give packed cells instead of whole blood as these have a smaller volume.
- Give broad-spectrum antibiotics (Second line and first line antibiotics together, Keep warm to prevent or treat hypothermia, sugar-water by mouth or naso-gastric tube, minimize disturbance including washing and transportation.

Table 7.4: Shock follow up chart

SIGNS OF SHOCK	Lethargic/unconscious, Cold hand, Slow capillary refill(>3 seconds), Weak/fast pulse											
	Start:	Monitor every 10 minutes					2nd hr:	Monitor every 10 minutes				
Time												
Resp. rate												
Pulse rate												
Passed urine (Y/N)												
Liver Size (cm)												
Weight												

7.6.3 Heart failure

Diagnosis: it should be considered when there are conditions like:

- Clinical deterioration with a gain in weight
- A sudden increase in liver size
- An increase in respiration rate
- Crepitations or rales in the lungs
- Prominent superficial and neck veins, etc.

Treatment

Stop all intakes of oral or IV fluids till it improves (Small amounts of sugar-water can be given orally to prevent hypoglycemia). Give furosemide SINGLE dose (1mg/kg),

If heart failure is associated with severe anaemia, treat as in section 7.6.5

7.6.4 Hypothermia

Diagnosis

Severely malnourished patients are highly susceptible to hypothermia. The child has hypothermia if axillary temperature is below 35°C).

Treatment

- Feed the child immediately with F-75 and every 2-3 hours,
- Use the "kangaroo technique" for children with a caretaker , Put a hat on the child and wrap mother and child together, Give hot drinks to the mother so her skin gets warmer (plain water, tea or any other hot drink),
- The room should be kept warm, especially at night (between 28°C and 32°C): a maximum- minimum thermometer should be on the wall of Phase 1 room to monitor the temperature. Treat for hypoglycemia and give second-line antibiotic treatment.

Prevent hypothermia through feeding the child 3-hourly including at night, and keeping the child warm: change wet nappies, and clothes and

bedding, avoid exposing the child to cold (e.g. after bathing, or during medical examinations) and let the child sleep with the mother for warmth in the night.

- Give appropriate IV or IM antibiotics.

7.6.5 Severe Anemia (haemoglobin <4 g/dl)

Diagnosis: If the haemoglobin concentration is less than 4g/dl or the packed –cell volume is less than 12% in the first 48 hours after admission, the child has severe anaemia.

Treatment

Transfuse the child as follows if the child has severe anemia in the first 48 hours:

- Stop all oral intake and IV fluids during the transfusion.
- Look for signs of congestive heart failure such as fast breathing, respiratory distress, rapid pulse, engorgement of the jugular vein, cold hands and feet, cyanosis of the fingertips and under the tongue.
- Give Furosemide 1 mg/kg, given by IV.
- If there are no signs of congestive heart failure, transfuse whole fresh blood at 10 ml/kg slowly over 3 hours. If there are signs of heart failure, give 10 ml/kg packed cells over 3 hours instead of whole blood.
- Monitor the pulse and breathing rate every 15 minutes during the transfusion. If either increases (RR by 5 breaths/min or PR by 25 beats/min), transfuse more slowly.

- As malnutrition is usually not the cause of severe anaemia, it is important to investigate other possible causes such as malaria and intestinal parasites (for example, hookworm) and treat accordingly.

Note:

- If the Hgb remains low after the transfusion, don't repeat it with in 4 days.
- Most heart failure between 2-14 days is not due to severe anemia. Please consider other diagnosis before deciding to transfuse.

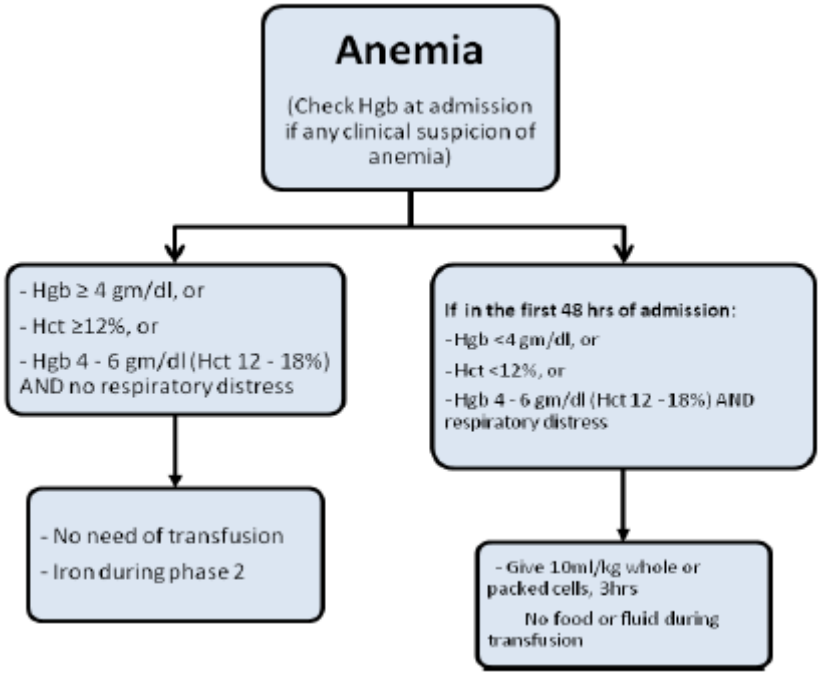

Anemia
(Check Hgb at admission if any clinical suspicion of anemia)
- Hgb ≥ 4 gm/dl, or
- Hct ≥12%, or
- Hgb 4 - 6 gm/dl (Hct 12 - 18%) AND no respiratory distress
- No need of transfusion
- Iron during phase 2
If in the first 48 hrs of admission:
-Hgb <4 gm/dl, or
-Hct <12%, or
-Hgb 4 - 6 gm/dl (Hct 12 - 18%) AND respiratory distress
- Give 10ml/kg whole or packed cells, 3hrs
No food or fluid during transfusion

Figure 7.4: Flow chart for treatment of anemia

7.6.6 Hypoglycemia

All severely malnourished children are at risk of hypoglycaemia and, immediately on admission, should be given a feed or 10% glucose or sucrose.

Diagnosis: it is diagnosed if blood glucose is <3 mmol/l (<54 mg/dl). If the blood glucose cannot be measured, it should be assumed that all children with severe malnutrition have hypoglycaemia.

- If the child can drink, give 50 ml bolus of 10% glucose or 10% sucrose orally. If the child is alert but not drinking, give the 50 ml by NG tube.
- If the child is lethargic, unconscious, or convulsing, give 5 ml/kg body weight of sterile 10% glucose by IV, followed by 50 ml of 10% glucose or sucrose by NG tube.* If the IV dose cannot be given immediately, give first dose through NG tube.

  * If the child will be given IV fluids for shock, there is no need to follow the 10% IV glucose with an NG bolus, as the child will continue to receive glucose in the IV fluids.

- Start feeding F-75 half an hour after giving glucose and give it every half-hour during the first 2 hours. For a hypoglycaemic child, the amount to give every half-hour is ¼ of the 3-hourly amount shown on the F-75 Reference Card.
- Take another blood sample after 2 hours and check the child's blood glucose again.
  - If blood glucose is 54 mg/dl (3mmol/l) or higher, change to 3-hourly feeds (8 feeds per day) of F-75.

- If it is still low, make sure antibiotics and F-75 have been given. Keep giving F-75 every half-hour and **Treat with second-line antibiotics.**

Prevent hypoglycemia by feeding 2-3 hourly, starting immediately and throughout the night and preventing hypothermia as explained in section 7.6.4

7.6.7 Eye Problems

If the child has any eye signs of vitamin A deficiency,

- Give vitamin A orally on days 1, 2 and 14 (aged <6 months, 50 000 IU; aged 6–12 months, 100 000 IU; older children, 200 000 IU). If the first dose was given in the referring centre, treat on days 1 and 14 only.

  If the eyes show signs of corneal clouding or ulceration, give additional care to the affected eye(s) to prevent corneal rupture and extrusion of the lens:
- Instil chloramphenicol or tetracycline eye drops, 4 times daily as required for 7–10 days,
- Instil atropine eye drops, 1 drop 3 times daily for 3–5 days,
- Cover with saline-soaked eye pads, and bandage the eye(s).If the child falls asleep with his eyes open, close them gently to protect them.

7.6.8 Dermatosis

Dermatosis is more common in children who have oedema than in wasted children. When the skin is raw and weeping, this risk of infection is very high. The extent of dermatosis can be described as follows:

+ Mild: discoloration or a few rough patches of skin

+ + Moderate: multiple patches on arms and/or legs

+ + + Severe: flaking skin, raw skin, fissures (openings in the skin)

Treatment

Use regular soap for bathing if the child does have mild or moderate dermatosis.

Treat the child with severe (+++) dermatosis as follows:

- Bathe for 10-15 min/day in 1% potassium permanganate solution. To make a 1% solution, dissolve a crystal in enough water so that the colour is slightly purple and still transparent. Sponge the solution onto affected areas while the child is sitting in a basin. This dries the lesions, helps to prevent loss of serum and inhibits infection. If potassium permanganate solution is not available, affected areas may be dabbed with gentian violet. If the child has severe dermatosis but is too sick to be bathed, dab 1% potassium permanganate solution on the bad spots, and dress oozing areas with gauze to keep them clean.
- Apply barrier cream to raw areas. Useful ointments are zinc and castor oil ointment, petroleum jelly, or paraffin gauze dressing. These help to relieve pain and prevent infection.
- If the diaper area becomes colonised with candida, use nystatin ointment or cream after bathing. (Candidiasis is also treated with oral Nystatin)
- Leave off diapers (nappies) so the affected area can dry. Be sure to dry the child well after a bath and wrap the child warmly.

7.7 Routine Medicines

Children with SAM should be provided the following routine drugs.

7.7.1 Vitamin A

- On the day of admission (day 1), give vitamin A for all children except those with oedema or those who received vitamin A in the past 6 months.
- Give vitamin A to every patient on the day of discharge (in-patient care) or at the 4th week of the treatment for those in out-patient care.
- Dose: <6 months: 50,000IU PO at admission; 6-11 months: 100,000IU; ≥12 months: 200,000IU

7.7.2 Folic Acid

- On the day of admission, one single dose of folic acid (5mg for 6 moths to 5 years and 2.5mg stat for infants) can be given to children with clinical signs of anaemia.

7.7.3 Antibiotics

Antibiotics should be given to every patient with SAM, even if they do not have clinical signs of systemic infection.

- If no complications, give first line antibiotics: oral Amoxicillin for 7 days (preferred) or cotrimoxazole.
- If complications present, give second line antibiotics: Gentamicin, plus IV Ampicillin for 2 days followed by Amoxicillin depending on the condition of the child, for a total treatment duration of 7 days.
  - If the child fails to improve within 48 hours, add chloramphenicol or change to Amxicillin/clavulinic acid or
  - Ceftriaxone

- Use the dose and schedule in table 7.2
- Route of administration: best route is oral or through NGT
- Duration: In-patient care: every day during Phase 1 + four more days or until transfer to OTP; Out-patient care: for 7 days total.
- If specific infections are identified which require a specific antibiotic not already being given, give an additional antibiotic to address that infection. For example, dysentery may require additional antibiotics. Certain skin infections such as Candidiasis require specific antifungals. Antimalarial treatment if the child has a positive blood film for malaria parasites.
- Frequently a systemic anti-fungal (Fluconazole) is added for any patient who has signs of severe sepsis or systemic candidiasis

Table 7.5 choice of antibiotics for children with SAM

IF:	**GIVE:**
NO COMPLICATIONS	Oral Amoxicillin for 7 days **or Cotrimoxazole** for 5 days if Amoxicillin is not available
COMPLICATIONS(shock, hypoglycaemia, hypothermia, dermatosis with raw skin/fissures, respiratory or urinary tract infections, or lethargic/sickly appearance)	**Gentamicin**1 IV or IM once daily for 7 days, **plus: Ampicillin** IV or IM every 6 hours for 2 days followed by oral **Amoxicillin** for 5 days
If child fails to improve within 48 hours, ADD:	**Chloramphenicol** IV or IM every 8 hours for 5 days. (Give every 6 hours if suspect meningitis.) Or ceftriaxone 100 mg/kg divided into 2 doses IV or IM + gentamicin once daily for a total of 10 days.
If a specific infection requires an additional antibiotic, ALSO GIVE:	**Specific antibiotic** as indicated.

Table 7.6 Dosage of selected oral antibiotics in SAM

WEIGHT Kg	AMOXYCILLIN (50-100mg/Kg/d) Give two times/day			CHLORAMPHENICOL (50mg/Kg/d) Give three times/day		COTRIMOXAZOLE (25mg SMX+5mg TMP/Kg/d) Give two times/day		
	ADULT TABLET 500mg	PEDIATRIC TABLET 125 mg	SYRUP 125 mg/5ml	CAPSULE 250mg	CAPSULE 125 mg	TABLET 240mg	TABLET 120mg	SYRUP 120mg/5ml
<5	¼	1	5.0 ml	¼	½	½	1	5ml
5-10	½	2	10ml	½	1	1	2	10ml
10-20	1	4	20ml	1	2	2	4	20ml
20-35	1½	6	30ml	2	4	3	6	30ml
>35	2	8	40ml	4	8	4	8	40ml

Table 7.7 Dosage of selected parenteral antibiotics in SAM

WEIGHT in Kg	AMPICILLINE (50mg/Kg/ dose) 4 times/day for 2 days	GENTAMYCIN (5-7.5 mg/Kg/day) Once per day for 2 days.	CHLORAMPHENICOL (25/Kg/dose) 3 times/day	CEFTRIAXONE (50mg/Kg/dose) 2 times per day
	Vial of 500mg/2.5ml	10 mg/ml ampoule	1000mg/10ml	1000mg/10ml ampoule
<5	1ml	2.5 ml	1 ml	2 ml
5-10	2 ml	5 ml	2 ml	4 ml
10-20	4 ml	10 ml	4 ml	8 ml
20-35	6ml	15 ml	6 ml	12 ml
>35	8 ml	20 ml	10 ml	20 ml

7.7.4 Iron

It is added to the F100 in Phase 2. Add 1 crushed tablet of ferrous sulphate (200mg) to each 2 litres to 2.4 litres of F100. For lesser volumes: 1000 to 1200ml of F100, dilute one tab of ferrous sulphate (200mg) in 4ml water and add 2ml of the solution. For 500ml to 600ml of F100, add 1ml of the solution. RUTF already contains the necessary iron.

7.7.5. Measles vaccine

All children from 9 months without a vaccination card should be given measles vaccine both on admission and discharge after Phase 2.

7.7.6. Deworming

Albendazole or Mebendazole is given for children ≥1 year at the start of Phase 2 for patients that will remain as in patients. For both those transferred from in-patients to Phase 2 as out-patients and those admitted directly to OTP de-worming is given at the 2nd out-patient visit (after 7 days).

Table 7.8 Deworm the child as in the table below

Age	< 1 year	1-2 years	**> 2** years
Albendazole 400 mg	Not given	Half tablet once	one tablet once
Mebendazole 100 mg	Not given	One and half tablet once	Five tablets once

Table 7.9 Summary of routine medicines in SAM

	Direct admission to in-patient (Phase 1)	**Direct admission to out-patient (Phase 2)**
Vitamin A	- 1 dose at admission (conditional) - 1 dose on discharge - do not give when transferred to OTP management - it will be given in OTP	- 1 dose on the 4th week (4th visit)
Folic Acid	- 1 dose at admission if signs of anaemia	- 1 dose at admission if signs of anaemia
Amoxicillin	- Every day in Phase 1 + 4 more days in Transition	- 1 dose at admission + give treatment for 7 days at home
Malaria	- According to national protocol	- According to national protocol
Measles (from 9 months old)	- 1 vaccine at admission if no card - 1 vaccine at discharge	- 1 vaccine on the 4th week (4th visit)
Iron	- Add to F100 in Phase 2	- No - iron is already in all RUTF
Deworming	- 1 dose at the start of Phase 2	- 1 dose on the 2nd week (2nd visit)

7.8 Dietary Treatment

To prevent death, feeding should begin as soon as possible with F-75, the "starter" formula used until the child is stabilized. F-75 is specially made to meet the child's needs without overwhelming the body's systems at this early stage of treatment. F-75 contains 75 kcal and 0.9 g protein per 100 ml. F-75 is low in protein and sodium and high in carbohydrate, which is more easily handled by the child and provides much-needed glucose.

When the child is stabilized (usually after 2 to 7 days), the "catch-up" formula F-100 or RUTF is used to rebuild wasted tissues. F-100 contains more calories and protein: 100 kcal and 2.9 g protein per 100 ml. This section will describe the three phases (Phase I, Transition phase and Phase 2) of feeding for in-patient care for children 6 moths- 5 years and under 6 months separately.

7.8.1 Feeding of Children 6 months to 5 years

I. **Phase I Feeding**

Use the F-75 table below (Table 7.9) to determine the amount F-75 and frequency of feeding. This amount of F-75 will give the child 100 kcal/kg/day and 1 - 1.5 g protein/kg/day and it is enough until the child is stabilized. Eight feeds per day are given for 24h in care units where there are sufficient staff to prepare and distribute the feeds at night. Six feeds per day are given where there are few staff at night.

It is best to feed the child with a cup (and spoon, if needed). It may be necessary to feed a very weak child with a dropper or syringe. Do not use a feeding bottle. Very occasionally it may be necessary to use a nasogastric (NG) tube if the child is very weak, has mouth ulcers that prevent drinking, has pneumonia with rapid respiration or if the child cannot take al least 75% F-75 by mouth.

Remove the NG tube when the child takes 75 % of the day's amount orally for two consecutive feeds.

Table 7.9.1 Amounts of F75 to give during Phase 1

Class of Weight (kg)	8 feeds per day ml for each feed	6 feeds per day ml for each feed	5 feeds per day ml for each feed
2.0 to 2.1 kg	40 ml per feed	50 ml per feed	65 ml per feed
2.2 - 2.4	45	60	70
2.5 - 2.7	50	65	75
2.8 – 2.9	55	70	80
3.0 - 3.4	60	75	85
3.5 – 3.9	65	80	95
4.0 – 4.4	70	85	110
4.5 – 4.9	80	95	120
5.0 – 5.4	90	110	130
5.5 – 5.9	100	120	150
6 – 6.9	110	140	175
7 – 7.9	125	160	200
8 – 8.9	140	180	225
9 – 9.9	155	190	250
10 – 10.9	170	200	275
11 – 11.9	190	230	275
12 – 12.9	205	250	300
13 – 13.9	230	275	350
14 – 14.9	250	290	375
15 – 19.9	260	300	400
20 – 24.9	290	320	450
25 – 29.9	300	350	450
30 – 39.9	320	370	500
40 – 60	350	400	500

Monitor and Record:

- Weight is measured, entered and plotted on the multichart each day.
- The degree of oedema (0 to +++) is assessed each day.
- Body temperature is measured four times per day.
- The standard clinical signs (stool frequency and consistency, vomiting, dehydration, cough, respiration, liver size, etc.) are assessed noted in multi-chart each day.
- Amounts of feed offered and left over

II. Transition Phase Feeding Treatment

It may take 2-7 days for the child to stabilize on F-75. When the child has stabilized, transfer into transition phase and offer F-100 or RUTF, the higher calorie, higher protein "catch-up" feed intended to rebuild wasted tissues. The following are signs of readiness to progress from Phase 1 to transition phase:

- Return of appetite (easily finishes 4-hourly feeds of F-75) and
- Reduced oedema or minimal oedema (++ or less) and
- No IV line, No NGT

During transition phase F-100 or RUTF should be given as follows:

- Give RUTF (Plumpy Nut) if children are going to continue treatment as out-patients (OTP) with take-home treatment rather than F100. Use Table 7.9.1 to determine the total amount of RUTF (Plumpy Nut) that should be taken during the day.

- Children who are not taking sufficient RUTF should be given F100 to make up any deficit in intake. Give F-100 every 4 hours in the same amount as you last gave F-75 if children can't take RUTF or are not going to continue treatment in OTP. Give F-100 based on the F-100 for transition (Table 7.9.1). Do not increase this amount for 2 days.

- Encourage the mother to breastfeed before and on demand between feeds of F-100 if the child is on breast feeding. As the patient is now taking more than maintenance amounts of food, weight gain is expected. The expected rate of weight gain, for marasmic patients, during transition phase is about 6 g/kg/day. Note that some of the patients may regress to phase 1 management.

III. Phase 2 Feeding

Transfer the child from transition phase to phase 2 if:

- The child finish 90% of the RUTF or F 100
- If the child has oedema and will continue phase 2 as inpatient, transfer if they lost the oedema. If they will continue phase 2 as an outpatient, transfer them if the oedema starts to reduce and become +.
- During phase 2, a child can feed freely on F-100 or RUTF. Most children will consume at least 150 kcal/kg/day; any amount less than this indicates that the child is not being fed freely or is unwell. Use the table below to determine the total amount of RUTF (Plumpy Nut) or F 100 that should be given to a child during phase 2. There are two options for Phase 2 feeding:
- If there is OTP in the area the child is living, transfer the child to Out Patient Treatment (OTP) to be treated at home with RUTF. The child should be transferred with sufficient RUTF (at least one week supply of RUTF.)
- Continue Phase 2 as in-patient: Treat with F-100 or RUTF in an in-patient care if there is no OTP service in the area where the child is living or for other medical reason the child should stay inpatient.
- If the child has been on RUTF during transition, continue RUTF as Table 7.9.1 below. If the child has been on F-100 during transition, preferably use RUTF as above or continue with F-100. On the first day of Phase 2, increase F-100 at each feed by 10 ml as long as the child is finishing feeds. If the child does not finish a feed, offer the

same amount at the next feed; then if feed finished, increase by 10 ml. Continue increasing the amount until some food is left after most feeds. Breast-fed children should always get the breast-milk before they are given F100 or RUTF

Table 7.9.2 Transition Phase: amounts of RUTF to give

Class of Weight	Beza	Plumpy Nut	BP100	total
	Gram/ day	Sachets/ day	Bars/ day	kcal
3 - 3.4	90	1.00	1.5	500
3.5 - 3.9	100	1.00	1.5	550
4 - 4.9	110	1.25	2.0	600
5 - 5.9	130	1.50	2.5	700
6 - 6.9	150	1.75	3.0	800
7 - 7.9	180	2.00	3.5	1000
8 - 8.9	200	2.00	3.5	1100
9 - 9.9	220	2.50	4.0	1200
10 - 11.9	250	3.00	4.5	1350
12 - 14.9	300	3.50	6.0	1600
15 - 19.9	370	4.00	7.0	2000
25 - 39	450	5.00	8.0	2500
40 - 60	500	6.00	10.0	2700

Move the child back to Phase 1 if:

- The patient gains weight more rapidly than 10g/kg/d (this indicates excess fluid retention)
- There is increasing oedema
- A child who does not have oedema develops oedema
- There is a rapid increase in the size of the liver
- Any other signs of fluid overload develop.
- Tense abdominal distension develops
- The patient gets significant re-feeding diarrhoea so that there is weight loss.
- Patient develops medical complication
- Naso-Gastric Tube is needed

- Patient takes less than 75% of the feeds in Transition Phase even after interchange between RUTF and F100

Criteria to transfer the child from transition phase to Phase 2:

- If the child has good appetite (taking at least 90% of the RUTF or F100).
- Oedematous children should remain in Transition Phase until there is a definite and steady reduction in oedema:
  - o For those who are going to remain as inpatients they should normally remain in Transition Phase until they have lost their oedema entirely.
  - o For those who are going to continue as OTP they can go when their appetite is good and they have reduced their oedema to ++ or +.

Table 7.9.3 Phase 2 Amount of F100 or RUTF to give at each feed for 5 or 6 feeds per day

Class of weight (kg)	6 feeds/ day		5 feeds/d	
	F100	RUTF	F100	RUTF
	ml/feed	g/feed	ml/feed	g/feed
<3 kg	Full strength F100 and RUTF are not given below 3kg			
3.0 to 3.4	110	20	130	25
3.5 - 3.9	120	22	150	30
4.0 - 4.9	150	28	180	35
5.0 - 5.9	180	35	200	35
6.0 - 6.9	210	40	250	45
7.0 - 7.9	240	45	300	55
8.0 - 8.9	270	50	330	60
9.0 - 9.9	300	55	360	65
10.0 – 11.9	350	65	420	75
12.0 – 14.9	450	80	520	95
15.0 – 19.9	550	100	650	120
20.0 - 24.9	650	120	780	140
25.0 – 29.9	750	140	900	160
30.0 - 39.9	850	160	1000	180
40 - 60	1000	180	1200	220

Table 7.9.4 Phase 2 (out-patients): amounts of RUTF to give

Follow Up for phase 2 is summarized in the table below

Class of weight (kg)	RUTF Paste		PLUMPY'NUT®		BP100®	
	Grams per day	Grams per week	sachet per day	sachet per week	bars per day	bars per week
3.0 - 3.4	105	750	1 ¼	8	2	14
3.5 - 4.9	130	900	1 ½	10	2 ½	17 ½
5.0 – 6.9	200	1400	2	15	4	28
7.0 – 9.9	260	1800	3	20	5	35
10.0 - 14.9	400	2800	4	30	7	49
15.0 – 19.9	450	3200	5	35	9	63
20.0 – 29.9	500	3500	6	40	10	70
30.0 - 39.9	650	4500	7	50	12	84
40 - 60	700	5000	8	55	14	98

Table 7.9.5 Surveillance of response for phase 2

Parameter	Frequency	
	Inpatient	Out patient
Weight and oedema	3 times per week	Every visit
Height/Length is measured	Every 3 weeks	As required Every month
Body temperature is measured	Every morning	Every visit
The standard clinical signs (stool, vomiting, etc)	Every day	Every visit
MUAC is taken	Every week	Every visit

Appetite test is done	Intake record is kept on chart	Every visit

Transfer the child from phase 2 to Phase 1 if the child:

- Develops any signs of a complication
- Develops or has increased oedema
- Develops refeeding diarrhoea sufficient to lead to weight loss.
- Loses weight for 2 consecutive weighing
- Has static weight for 3 consecutive weighing
- Fulfills any of the criteria of "failure to respond to treatment"

7.8.2 Feeding of infants less than 6 months

The feeding of infants is different from older children and it is also different for infants on breast feeding or with a caretaker willing to breast feed and for infants who can not be breast-fed. RUTF is not suitable for all infant less than 6 months, as the reflex of swallowing is not present yet.

1. Infants below six months on breast feeding or with a caretaker willing to breast feed

Infants who are malnourished are weak and do not suckle strongly enough to stimulate adequate production of breast milk. The feeding of these infants is to return them to full exclusive breastfeeding using supplementary suckling (SS) and feeding with diluted F-100. These infants have to be fed as follows:

- Breastfeed every three hours for at least 20 minutes (more if the child cries or demands more)
- Between one and a half hours after a normal breastfeed give maintenance amounts of F100-diluted using the SS technique (see the explanation below).
- Give diluted F100 in 8 feeds (use table 7.9.5 below to

determine the amount of diluted F-100)

- If the infant has no edema, there are not separate phases in the treatment of infants with the SS technique. There is no need to start with F75 and then switch to F100 diluted unless the infant has oedema.
- If the infant presents with oedema, start treatment with F75 instead of F100 diluted. After resolution of oedema, change to F100 diluted.

Supplementary suckling technique: The mother holds a cup with the F100 diluted. The end of a NG tube (size nº8) is put in the cup, and the tip of the tube on the breast, at the nipple. The infant is offered the breast in the normal way. The cup is placed 5 – 10 cm below the
level of the nipple for easy suckling. When the child suckles more strongly it can be lowered to up to 30 cm.



Figure 7.5 Suplementary suckling technique

Table 7.9.6 Amounts of F100 diluted (or infant formula) to give for infants during Supplementary Suckling (The quantity is NOT increased as the infant starts to gain weight)

Class of Weight (kg)	ml of F100 diluted per feed (8 feeds/day)
	Diluted F100
>=1.2 kg	25 ml per feed
1.3 to 1.5 kg	30
1.6 – 1.7	35
1.8 – 2.1	40
2.2 - 2.4	45
2.5 - 2.7	50
2.8 – 2.9	55
3.0 - 3.4	60
3.5 – 3.9	65
4.0 – 4.4	70

Follow up: The child is weighed every day. When the child is gaining we *Follow-uo:* The child is weighed every day. When the child is gaining weight at 20 g/day (absolute weigh gain) the quantity of F100 diluted in the cup is reduced so that the child gets more breast milk. If after this, weight gain is maintained then stop the supplement suckling completely. When it is certain that the child is gaining weight on breast milk alone he/she should be discharged, whatever his weight or weight-for-length. If the child is not gaining weight then continue with the SS technique, but increase the quantity of F100 diluted in the cup to 5 mls for each feed.

Care for the mothers: Check nutritional status of the mother (MUAC and oedema). Explain the treatment and discourage self-criticism for the lack of milk. She should drink at least 2 litres of water per day, and eat about 2500 kcal/day. She should also receive Vitamin A (200 000 IU unless there is a risk of pregnancy). Micronutrient supplementation must also be given to the mother.

II. Infants below six months who can not be breast-fed

Malnourished infants for whom there is no prospect of being breast-fed (e.g. no mother, no wet-nurse, or other medical indications) should be fed as follows:

Standard protocols are followed except that F100 is given diluted in the phase 1 (stabilization phase) (instead of F75) for children without edema (See table 7.9.6 to determine the amount).

Children with oedema are fed with F75. In transition and phase 2 use diluted F100 (RUTF is not suitable for these children) at inpatient facility.

- During Transition Phase, the amount of the diluted F100 in phase 1 is increased by one third.
- During phase 2, give diluted F 100 using table 7.9.7.

Table 7.9.7Amounts of F100 diluted to give for infants not breast-fed in Phase **1**

Class of Weight (kg)	ml of F100 per feed in Phase 1 (8 feeds/day)
	Diluted F100
=< 1.5 kg	30 ml per feed
1.6 to 1.8 kg	35 ml per feed
1.9 – 2.1	40
2.2 - 2.4	45
2.5 - 2.7	50
2.8 – 2.9	55
3.0 - 3.4	60
3.5 – 3.9	65
4.0 – 4.4	70

Table 7.9.8 Amounts of F100 diluted to give for infants not breast-fed in Phase 2

Class of Weight (kg)	ml of F100 per feed in Phase 2 (6 to 8 feeds/day)
	Diluted F100
=< 1.5 kg	60 ml
1.6 to 1.8 kg	70 ml
1.9 – 2.1	80
2.2 - 2.4	90
2.5 - 2.7	100
2.8 – 2.9	110
3.0 - 3.4	120
3.5 – 3.9	130
4.0 – 4.4	140

7.9 Failure to respond

It is only when children fulfill the criteria for "failure to respond" as stated in 7.9.9 and 7.9.10 (below) that they need to have an extensive history and examination or laboratory investigations conducted. Failure to respond to standard treatment is a "diagnosis" in its own right. Usual causes and general management of failure to respond is also summarized in table 7.9.11 below. The common causes should be systematically examined to determine and rectify the problems.

Table 7.9.9 Criteria of failure to respond for inpatients

Criteria for failure to respond	Time after admission
Primary failure to respond (phase 1)	
Failure to regain appetite	Day 4
Failure to start to loose Edema	Day 4
Oedema still present	Day 10
Failure to enter phase 2 and gain > 5g/kg/d	Day 10
Secondary failure to respond	
Failure to gain more than 5g/kg/d for 3 successive days	During Phase 2

Table 7.9.10 Criteria of failure to respond for outpatients

Criteria for failure to respond	Time after admission
Primary failure to respond	
Failure to gain any weight (non-oedematous children)	21 days
Failure to start to loose Edema	14 days
Oedema still present	21 days
Secondary failure to respond	
Failure of Appetite test	At any visit
Weight loss of 5% of body weight	At any visit
Weight loss for two successive visits	During OTP care
Failure to gain more than 2.5g/kg/d for 21days (after loss of oedema (kwashiorkor) or after day 14 (marasmus)	During OTP care

Table 7.9.11 Possible causes of failure to respond

Problems with the treatment facility:

In –patients

- Poor environment for malnourished children
- Failure to treat the children in a separate area
- Failure to complete the multichart correctly
- Insufficient staff (particularly at night)
- poorly trained staff
- Inaccurate weighing machines
- Food prepared or given incorrectly

Out – patients

- Inappropriate selection of patients to go directly to OTP
- Poorly conducted appetite test
- Inadequate instructions given to caretakers
- Wrong amounts of RUTF dispensed to children
- Excessive time between OTP distributions (e.g. two weekly gives significantly worse results than weekly visits)

Problems of individual children:

In –patients

- Insufficient food given
- Food taken by siblings or caretaker
- Sharing of caretaker's food
- Vitamin or mineral deficiency
- Malabsorption
- Psychological trauma (particularly in refugee situations and families living with HIV/AIDS)
- Rumination
- Infection, especially: Diarrhoea, dysentery, pneumonia, tuberculosis, urinary infection/ Otitis media, malaria, HIV/AIDS, Schistosomiasis/ Leishmaniasis, Hepatitis/ cirrhosis,
- Other serious underlying disease: congenital abnormalities (e.g. Down's syndrome), neurological damage (eg cerebral palsy), inborn errors of metabolism.

Out – patients (In addition to all of the above)

- Sharing within the family
- Sibling rivalry (other children taking the diet)
- All eating from the same plate (the malnourished child should always have his/her own portion of food).
- Unwilling caretaker
- Caretaker overwhelmed with other work and responsibilities

7.10 Discharge Criteria

Children should be discharged from therapeutic feeding Program (TFP) or in-patient care if they fulfill the following criteria:

Age	Discharge Criteria
6 months – 5 years	• Weight-for-length or height ≥ 85% and no oedema for 10 days (In-patient) or • Target weight gain if the child is admitted with MUAC

Note: Transfer from in-patient care to OTP is not considered as an early discharge

Age	Discharge Criteria
<6 monthson breastfeeding or with a caretaker willing to breast feed	Infant gaining weight on breast milk alone No medical problem Mother is adequately supplemented with vitamins and minerals There are no anthropometric criteria for discharge of the fully breast-fed infant who is gaining weight.

Age	Discharge Criteria
<6 months who cannot be breast-fed	When they reach 85% weight for length, they can be switched to infant formula.

If early discharge is necessary, many preparations must be made to ensure that the parents can continue care at home. Follow-up visits are essential.

7.11 Monitoring the quality of care

7.11.1 Mortality audit

A register of admissions, discharges and deaths should be kept. This should contain information about the children (such as weight, age and sex), day of admission, date of discharge or date and time of death.

To identify factors that can be changed to improve care, determine whether most of the deaths occurred:

- Within 24 h: consider untreated or delayed treatment of hypoglycaemia, hypothermia, septicaemia or severe anaemia, incorrect rehydration fluid or volume of fluid or overuse of IV fluids.
- Within 72 h: check whether the volume of feed given during re-feeding was too high or the formulation was wrong. Were potassium and antibiotics given?
- Over 72 h: consider nosocomial infection, re-feeding syndrome, heart failure and HIV infection.
- At night: consider hypothermia due to insufficient covering of the child or no night feeds.
- When beginning F-100 or RUTF: consider too rapid a transition from starter to catch-up feeds.

7.11.2 Weight gain during rehabilitation

Standardize weighing on the hospital ward. Calibrate the scales every day.

Weigh children at the same time each day (e.g. morning) after removing clothes (but avoid hypothermia).

Weight gain is defined as:

- Poor: < 5 g/kg per day
- Moderate: 5–10 g/kg per day
- Good: > 10 g/kg per day.

If the weight gain is < 5 g/kg per day, determine whether this occurred:

- In all children being treated (if so, a major review of case management is required)
- Inspecific cases (reassess these children as if they were new admissions).

General aspects to be checked if weight gain is poor are described below.

Inadequate feeding

Check:

- That night feeds are given
- That target energy and protein intakes are achieved. Is the actual intake (i.e. what was offered minus what was left over) correctly recorded? Is the quantity of feed recalculated as the child gains weight? Is the child vomiting or ruminating?
- Feeding technique: Is the child given frequent feeds in unlimited amounts?
- Quality of care: Are staff motivated, gentle, loving and patient?
- All aspects of feed preparation: scales, measurement of ingredients, mixing, taste, hygienic storage, adequate stirring if separating out
- Whether the complementary foods given to the child are energy-dense enough
- Adequacy of multivitamin composition and shelf-life
- Preparation of mineral mix and whether correctly prescribed and administered.

If you are in a goitrous region, check whether potassium iodide is added to the electrolyte/mineral mix (12 mg/2500 ml), or give all children Lugol iodine (5–10 drops a day). if complementary foods are given, check that they contain electrolyte/mineral solution.

Untreated infection

If feeding is adequate and there is no malabsorption, suspect a hidden infection if there is recurrence of oedema, hypoglycaemia or hypothermia. The following are easily overlooked: urinary tract infections, otitis media, TB and giardiasis. In such cases:

- Re-examine carefully
- Repeat urine microscopy for white blood cells
- Examine the stools
- If possible, take a chest X-ray.

Consider treatment in the absence of a confirmatory diagnosis.

HIV/AIDS

Children with HIV and AIDS can recover from malnutrition, but it may take longer, and treatment failures are commoner. Initial nutritional treatment of severe acute malnutrition in children with HIV/AIDS should be the same as for HIV-negative children.

For other HIV-related conditions, see Chapter 8.

Psychosocial stimulation

Check for abnormal behaviour, such as stereotyped movements (rocking), rumination (i.e. self-stimulation through regurgitation) and attention-seeking.

Treat by giving the child special love and attention. For children who ruminate, firmness with affection can assist. Encourage the mother to

spend time playing with her child.

Provide:

- Tender loving care
- Always uncover the child's face to help able to see and hear what is happening around the child wrapped or tied except for the purpose of protecting from hypothermia.
- A cheerful stimulating environment
- Structured play therapy for 15–30 minutes a day
- Physical activity as soon as the child is well enough
- Maternal involvement as much as possible (e.g. comforting, feeding, bathing, play).
- Provide suitable toys for the child (see chapter 10 sec 10.8). Ideas for the organization of play activities are also given.

CHAPTER 8 - CHILDREN WITH HIV/AIDS

8.1 HIV/AIDS

In general, the management of specific conditions in HIV-infected children is similar to that in other children. Most infections in HIV positive children are caused by the same pathogens as in HIV-negative children, although they may be more frequent, more severe and occur repeatedly. Some, infections, however, are due to unusual pathogens.

Many HIV-positive children die from common childhood illnesses, and some of these deaths are preventable by early diagnosis and correct management or by giving routine scheduled vaccinations and improving nutrition. These children have a particularly greater risk for staphylococcal and pneumococcal infections and TB. Saving children's lives depends on early identification, immediate treatment with ART and co-trimoxazole prophylaxis for those who are HIV-infected.

All infants and children should have their HIV status established at their first contact with the health system, ideally at birth or at the earliest opportunity thereafter. To facilitate this, all areas of the hospital in which maternal, neonatal and child services are delivered should offer HIV serological testing to mothers and their infants and children.

This chapter covers mainly the management of children with HIV/AIDS: diagnosis of HIV infection, counselling and testing, clinical staging, ART, management of HIV-related conditions, supportive care, breastfeeding, planning discharge and follow-up and palliative care for terminally ill children.

8.2 Sick child with suspected or confirmed HIV infection

8.2.1 Clinical diagnosis

The clinical expression of HIV infection in children is highly variable. Many HIV-positive children show severe HIV-related signs and symptoms in the first year of life, while others may remain asymptomatic or mildly symptomatic for more than a year and may survive for several years.

Clinical experience indicates that children infected with HIV perinatally who are not on antiretroviral therapy fit into one of three categories:

- Those with rapid progression (25–30%), most of whom die before their first birthday; they are thought to have acquired the infection in utero or during the early postnatal period;
- Children, who develop symptoms early in life, then follow a downhill course and die at the age of 3–5 years (50–60%);
- Long-term survivors, who live beyond 8 years of age (5–25%); they tend to have lymphoid interstitial pneumonitis and stunting, with low weight and height for age.

Suspect HIV if any of the following signs, which are not common in HIV-negative children, are present:

Signs that may indicate possible HIV infection

- Recurrent infection: three or more severe episodes of a bacterial infection (such as pneumonia, meningitis, sepsis, cellulitis) in the past 12 months
- Oral thrush: erythema and white-beige pseudomembranous plaques on the palate, gums and buccal mucosa. After the neonatal period, the presence of oral thrush is highly suggestive of HIV infection when it lasts > 30 days despite antibiotic treatment, recurs, extends beyond the tongue or presents as oesophageal candidiasis.
- Chronic parotitis: unilateral or bilateral parotid swelling (just in front of the ear) for ≥ 14 days, with or without associated pain or fever.

- Generalized lymphadenopathy: enlarged lymph nodes in two or more extrainguinal regions with no apparent underlying cause.

Hepatomegaly with no apparent cause: in the absence of concurrent viral infections such as cytomegalovirus.

Persistent and/or recurrent fever: fever (> 38 °C) lasting ≥ 7 days or occurring more than once over 7 days.

- Neurological dysfunction: progressive neurological impairment, microcephaly, delay in achieving developmental milestones, hypertonia or mental confusion.
- Herpes zoster (shingles): painful rash with blisters confined to one dermatome on one side
- HIV dermatitis: erythematous papular rash. Typical skin rashes include; extensive fungal infections of the skin, nails and scalp and extensive molluscum contagiosum.
- Chronic suppurative lung disease

Signs or conditions specific to HIV-infected children

Strongly suspect HIV infection if the following are present:

- Pneumocystis jiroveci (formerly carinii) pneumonia (PCP)
- Oesophageal candidiasis
- Lymphocytic interstitial pneumonia
- Kaposi sarcoma
- Acquired recto-vaginal fistula (in girls)

Signs common in HIV-infected children but which also occur in ill children with no HIV infection

- Chronic otitis media: ear discharge lasting ≥ 14 days
- Persistent diarrhoea: diarrhoea lasting ≥ 14 days

- Moderate or severe acute malnutrition: weight loss or a gradual but steady deterioration in weight gain from that expected, as indicated on the child's growth chart. Suspect HIV particularly in breastfed infants < 6 months old who fail to thrive.

8.2.2 HIV Counseling

HIV provider-initiated testing and counseling should be offered to all under-five children attending clinical services. If the child's HIV status is not known, counsel the family and offer diagnostic testing for HIV.

As the majority of children are infected by vertical transmission from the mother, the mother and often the father are probably infected but may not know it. HIV still remains a stigmatizing condition, and the parents may feel reluctant to undergo testing.

In HIV counseling, the child should be treated as part of the family by taking into account the psychological implications of HIV for the child, mother, father and other family members. Counselors should stress that, although there is no definitive cure, early initiation of ART and supportive care can greatly improve the child's and the parents' quality of life and survival.

Counseling requires time and must be done by trained staff. If there are no trained staff, assistance should be sought from local AIDS support organizations.

HIV testing should be voluntary, with no coercion, and informed consent should be obtained before testing is performed.

Indications for HIV counseling and testing

All infants and children with unknown HIV status should be offered counseling and testing. In most cases, the HIV status of the child is established by asking about maternal HIV testing during pregnancy, labour

or postpartum and checking the child's or mother's health card. If the HIV status is not known, counselling and testing should be offered in the following situations to:

- All under-five children visiting health facilities
- All HIV-exposed infants at 6 weeks of age or at the earliest opportunity thereafter.
- Any infant or child presenting with signs, symptoms or medical conditions that could indicate HIV infection.
- All pregnant women and their partners

8.2.3 Testing and diagnosis of HIV infection

Diagnosis of HIV infection in perinatally exposed infants and young children < 18 months of age is difficult, because passively acquired maternal HIV antibodies may still be present in the child's blood. Additional diagnostic challenges arise if the child is still breastfeeding or has been breastfed. Although many children will have lost HIV antibodies between 9 and 18 months, a virological test is the only reliable method for determining the HIV status of a child < 18 months of age.

When either the mother or the child has a positive serological HIV test and the child has specific symptoms suggestive of HIV infection but virological testing is not available, the child may presumptively be diagnosed as having HIV infection. However, HIV virological testing should be done at the earliest opportunity to confirm infection.

All diagnostic HIV testing of children must be confidential, be accompanied by counseling and conducted only with informed consent, so that it is both informed and voluntary.

HIV serological antibody test (ELISA or rapid tests)

Rapid tests are widely available, sensitive and reliable for diagnosing HIV infection in children 18 months and above. For children < 18 months, HIV antibody tests are a sensitive, reliable way of detecting exposure and of excluding HIV infection in non-breastfeeding children.

Rapid HIV tests can be used to exclude HIV infection in a child presenting with severe acute malnutrition, or TB or any other serious clinical event in areas of high HIV prevalence. For children aged < 18 months, confirm all positive HIV serological results by virological testing as soon as possible (see below). When this is not possible, repeat antibody testing at 18 months.

Virological tests

Virological testing for HIV-specific RNA or DNA is the most reliable method for diagnosing HIV infection in children < 18 months of age. This may require sending a blood sample to a specialized laboratory that can perform this test. The tests are relatively cheap, easy to standardize and can be done on dried blood spots. The following assays (and respective specimen types) may be available:

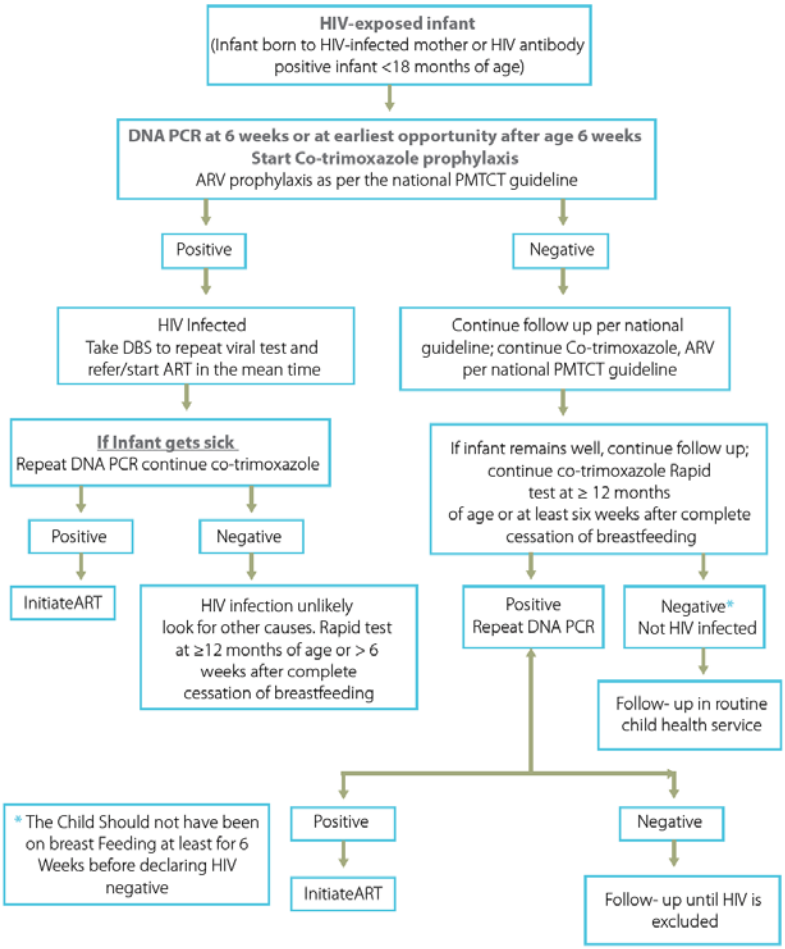
- HIV DNA on whole blood specimen or dried blood spots
- HIV RNA on plasma or dried blood spots
- Ultrasensitive p24 antigen detection in plasma or dried blood spots
- One positive virological test is sufficient to diagnose HIV infection in a young infant. ART should be started without delay, and, at the same time, a second specimen should be collected to confirm the positive virological test result.

- If the infant is still breastfeeding and the virological test is negative, it should be repeated 6 weeks after complete cessation of breastfeeding to confirm that the child is not infected with HIV.
- The results of virological testing in infants should be returned to the clinic and to the child, mother or carer as soon as possible but at the very latest within 4 weeks of specimen collection.

8.2.4 Diagnosing HIV infection in breastfeeding infants

A breastfeeding infant is at risk of acquiring HIV infection from an infected mother throughout the period of breastfeeding. Breastfeeding should not be stopped in order to perform diagnostic HIV viral testing. Positive test results should be considered to reflect HIV infection. The interpretation of negative results is, however, difficult because a 6-week period after complete cessation of breastfeeding is required before negative viral test results can reliably indicate HIV infection status.

Algorithm for testing of HIV Exposed Infants <18 months


HIV-exposed infant
(Infant born to HIV-infected mother or HIV antibody positive infant <18 months of age)
DNA PCR at 6 weeks or at earliest opportunity after age 6 weeks
Start Co-trimoxazole prophylaxis
ARV prophylaxis as per the national PMTCT guideline
Positive
Negative
HIV Infected
Take DBS to repeat viral test and refer/start ART in the mean time
Continue follow up per national guideline; continue Co-trimoxazole, ARV per national PMTCT guideline
If Infant gets sick
Repeat DNA PCR continue co-trimoxazole
If infant remains well, continue follow up; continue co-trimoxazole Rapid test at ≥ 12 months of age or at least six weeks after complete cessation of breastfeeding
Positive
Negative
InitiateART
HIV infection unlikely look for other causes. Rapid test at ≥12 months of age or > 6 weeks after complete cessation of breastfeeding
Positive Repeat DNA PCR
Negative* Not HIV infected
Follow- up in routine child health service
* The Child Should not have been on breast Feeding at least for 6 Weeks before declaring HIV negative
Positive
Negative
InitiateART
Follow- up until HIV is excluded

NB: *If the first test is positive and the confirmatory virological test is negative, a third test will be needed to resolve the discordance between the two earlier virological tests (WHO recommendations on the diagnosis of HIV infection in infants and children, 2010).*

Clinical staging

In a child with diagnosed or highly suspected HIV infection, the clinical staging system helps to determine the degree of damage to the immune system and to plan treatment and care.

The clinical stages represent a progressive sequence from least to most severe, each higher clinical stage indicating a poorer prognosis. Initiating ART, with good adherence, dramatically improves the prognosis. Clinical staging events can be used to identify the response to ART if there is no easy access to tests for viral load or CD4 count.

CLINICAL STAGING

WHO paediatric clinical staging system for HIV infection

For use in children aged <14 years with confirmed laboratory evidence of HIV infection (HIV antibodies for children > 18 months, virological testing for those aged < 18 months)

STAGE 1

- Asymptomatic
- Persistent generalized lymphadenopathy

STAGE 2

- Hepatosplenomegaly
- Papular pruritic eruptions
- Seborrhoeic dermatitis
- Fungal nail infections
- Angular cheilitis
- Linear gingival erythema
- Extensive human papillomavirus infection or molluscum infection (> 5% body area)
- Recurrent oral ulcerations (two or more episodes in 6 months)

- Parotid enlargement
- Herpes zoster
- Recurrent or chronic upper respiratory tract infection (otitis media, otorrhoea, sinusitis; two or more episodes in any 6-month period)

STAGE 3

- Unexplained moderate malnutrition that does not respond to standard therapy
- Unexplained persistent diarrhoea (> 14 days)
- Unexplained persistent fever (intermittent or constant, for > 1 month)
- Oral candidiasis (outside neonatal period)
- Oral hairy leukoplakia
- Pulmonary TB[a]
- Severe recurrent presumed bacterial pneumonia (two or more episodes in 6 months)
- Acute necrotizing ulcerative gingivitis or periodontitis
- Lymphoid interstitial pneumonia
- Unexplained anaemia (< 8 g/dl), neutropenia (< 500/mm3) or thrombocytopenia (< 30 000/mm3) for > 1 month
- HIV-related cardiomyopathy
- HIV-related nephropathy

STAGE 4

- Unexplained severe wasting or severe malnutrition that does not respond to standard therapy
- PCP
- Recurrent severe presumed bacterial infections (two or more episodes within 1 year, e.g. empyema, pyomyositis, bone or joint infection, meningitis, but excluding pneumonia)

- Chronic orolabial or cutaneous herpes simplex infection (lasting > 1 month)
- Disseminated or extrapulmonary TB
- Kaposi sarcoma
- Oesophageal candidiasis
- Symptomatic HIV seropositive infant < 18 months with two or more of the following: oral thrush, severe pneumonia, failure to thrive, severe sepsis[b]
- Cytomegalovirus retinitis
- Central nervous system toxoplasmosis
- Any disseminated endemic mycosis, including cryptococcal meningitis (e.g. extrapulmonary cryptococcosis, histoplasmosis, coccidiomycosis, penicilliosis)
- Cryptosporidiosis or isosporiasis (with diarrhoea lasting > 1 month)
- Cytomegalovirus infection (onset at age > 1 month in an organ other than liver, spleen or lymph nodes)
- Disseminated mycobacterial disease other than TB
- Candida of trachea, bronchi or lungs
- Acquired HIV-related rectovesical fistula
- Cerebral or B cell non-Hodgkin lymphoma
- Progressive multifocal leukoencephalopathy
- HIV encephalopathy

A. TB may occur at any CD4 count; the percentage CD4 should be considered when available.

B. Presumptive diagnosis of stage 4 disease in seropositive children < 18 months requires confi rmation with HIV virological tests or an HIV antibody test after 18 months of age.

8.3 Antiretroviral therapy

The current standard first-line treatment for HIV infection is use of three antiretroviral medications (triple drug therapy) to suppress viral replication as much as possible and thus arrest the progression of HIV disease. Fixed-dose combinations are now available and are preferable to syrups or single drugs because they encourage adherence to treatment, and reduce the cost. Clinicians should be familiar with the national paediatric HIV treatment guidelines.

The underlying principles of ART and the choice of first-line drugs for children are largely the same as for adults. Suitable formulations for children may not be available for some antiretroviral drugs (particularly the protease inhibitor class). It is nevertheless important to consider:

- The availability of a suitable formulation that can be taken in appropriate doses
- The simplicity of the dosage schedule
- The taste and palatability, and hence compliance, for young children.
- It is also important to ensure that HIV-infected parents access treatment; and ART should ideally be ensured for other family members.

8.3.1 Antiretroviral drugs

Antiretroviral drugs fall into three main classes:

- Nucleoside reverse transcriptase inhibitors (NRTIs),
- Non-nucleoside reverse transcriptase inhibitors (NNRTIs), and
- Protease inhibitors

Triple therapy is the standard of care, and first-line regimens should be based on two NRTIs plus one NNRTI or protease inhibitor.

All infants and children < 3 years of age should be started on Lopinavir/Ritonavir (LPV/r) plus two NRTIs, regardless of exposure to nevirapine (NVP) to prevent mother-to-child transmission. When viral load monitoring is available, consideration can be given to substituting LPV/r with an NNRTI after virological suppression is sustained.

For children ≥ 3 years, efavirenz (EFV) is the preferred NNRTI for first-line treatment particularly once daily therapy, although NVP may be used as an alternative especially for children who are on twice daily therapy. Efavirenz is also the NNRTI of choice in children who are on rifampicin, if treatment has to start before anti-TB therapy is completed.

Age	Preferred first line regimen	Alternative first line regimen
< 3 yrs	ABC or AZT+3TC+LPV/r	ABC+3TC+NVP AZT+3TC+NVP
3-10 yrs	AZT/ABC+3TC+EFV	ABC+3TC+NVP AZT+3TC+NVP TDF+3TC+EFV TDF+3TC+NVP
10-19 yrs	TDF+3TC+EFV (FDC)	ABC+3TC+EFV AZT+3TC+NVP TDF+3TC+NVP

Table 8.1 First-line treatment regimens for children

Dosing in children is usually based on either body surface area or weight, or, more conveniently, on weight bands. As these change with growth, drug doses must be adjusted in order to avoid the risk for under-dosage.

ANTIRETROVIRAL DRUGS

Table 8.2 Classes of antiretroviral drugs recommended for use in children

Nucleoside analogue reverse transcriptase inhibitors	
Zidovudine	ZDV (AZT)
Lamivudine	3TC
Abacavir	ABC
Emtricitabine	FTC
Tenofovir	TDF
Non-nucleoside analogue reverse transcriptase inhibitors	
Nevirapine	NVP
Efavirenz	EFV
Protease inhibitors	
Lopinavir/ritonavir	LPV/RTV
Atazanavir	ATZ

8.3.2 When to start antiretroviral therapy

Infants and young children have an exceptionally high risk of poor outcomes from HIV infection. Up to 52% and 75% of children die before the age of two and five years respectively in the absence of any intervention. By five years of age, the risk of mortality and disease progression in the absence of treatment falls to rates similar to those of young adults.

Diagnosing and retaining children exposed to HIV and children infected with HIV in care also presents unique challenges because of their dependence on a caregiver.

Loss to follow-up has been particularly high along the continuum of care, with retention especially challenging for children who are in HIV care but not yet eligible for ART.Where access to immunological testing is limited, the burden of pediatric HIV disease is high and pediatric ART coverage is

low, simplifying the eligibility criteria for initiating ART may significantly improve the overall health outcomes for children with HIV.

ART is recommended for all HIV infected children less than 15 years regardless of CD4 count and WHO clinical stage. Treating all children younger than fifteen years of age is expected to simplify pediatric treatment and facilitate a significant expansion of ART coverage for young children. Note that late diagnosis is still occurring, and a large proportion of the children identified as infected with HIV would already be eligible for ART based on previous recommendations.

Children < 15 years	All children with HIV infection regardless of CD4 count and WHO clinical stage

8.3.3 What ART regimen to start with (first-line ART)

Using simplified, less toxic and more convenient regimens as fixed-dose combinations is recommended for first-line ART. Once-daily regimens comprising NRTI backbone (TDF + 3TC) and one NNRTI (EFV) are maintained as the preferred choices in adults, adolescents and children older than ten years. For children younger than three years a PI-based regimen is the preferred approach.

Occasionally immediate initiation of ART treatment may be deferred until the child is stabilized during treatment of acute infections.

In the case of confirmed or presumptive TB, initiating TB treatment is the priority.

Any child with active TB should begin TB treatment immediately and start ART as soon as it can be tolerated but within the first 8 weeks of TB therapy.

For children on TB treatment:

- Children> 3 years and at least 10 kg, a regimen containing EFV is preferred.

- Children< 3 years of age, if the child is on a LPV/r-containing regimen, consider adding RTV in a 1:1 ration of LPV: RTV to achieve a full therapeutic dose of LPV.
- A triple NNRTI-containing regimen may be used as an alternative.

8.3.4 Side-effects and monitoring

Drug	Abbreviation	Side-effects [a]	Comments
Nucleoside reverse transcriptase inhibitors (NRTIs)			
Lamivudine	3TC	Headache, abdominal pain, pancreatitis	Well tolerated
Zidovudine	ZDV (AZT)	Headache, anaemia, neutropenia	
Abacavir	ABC	Hypersensitivity reaction, fever mucositis rash If these occur, stop the drug.	Tablets can be crushed
Emtricitabine	FTC	Headache, diarrhoea, nausea, and rash. May cause hepatotoxicity or lactic acidosis.	
Tenofovir	TDF	Renal insufficiency, decrease in bone mineral density	
Non-nucleoside reverse transcriptase inhibitors (NNRTIs)			
Efavirenz	EFV	Strange dreams, sleepiness, rash	Take at night; avoid taking with fatty food
Nevirapine	NVP	Rash, liver toxicity	When given with rifampicin, increase nevirapine dose by ~30% or avoid use. Drug interactions

Protease inhibitors			
Lopinavir/ ritonavir [b]	LPV/RTV	Diarrhoea, nausea Take with food; bitter taste	
Atazanavir	ATZ	Jaundice, prolonged PR interval, nephrolithiasis	

Common side-effects of antiretroviral drugs (Table 8.3)

a. General long-term side-effects of ART include lipodystrophy.

b. Requires cold storage and cold chain for transport

The response to and side-effects of ART should be monitored in all children on ART. A child's responses to therapy (i.e. reassessment of clinical status and stage, laboratory parameters and, symptoms of potential drug side effects or toxicity) should be done regularly. Common side effects are summarized in the table above.

Immune reconstitution inflammatory syndrome

Immune reconstitution inflammatory syndrome (IRIS) is a spectrum of clinical signs and symptoms associated with immune recovery brought about by a response to antiretroviral treatment. Although most HIV-infected children experience rapid benefi t from ART, some undergo clinical deterioration. This is the result of either the unmasking of latent or subclinical infection or the reactivation of previously diagnosed, and often treated, conditions (infectious or non-infectious).

The onset of IRIS in children usually occurs within the fi rst weeks to months after initiation of ART and is seen most often in children who

initiate ART with very low percentge CD4+ levels (< 15%). The commonest opportunistic infections associated with IRIS in children include:

- TB the commonest;
- Pneumocystis pneumonia (PCP) or cryptosporidiosis;
- Herpes simplex virus (HSV) infection;
- Fungal, parasitic or other infections.

Where BCG immunization of infants and children is routine, BCG-associated IRIS (localized and systemic) is frequently observed.
Most cases of paradoxical IRIS resolve spontaneously, or can be managed with non-steroidal anti-infl ammatory drugs, although some episodes can be severe and even lead to death.
Give specifi c treatment for the opportunistic infection
Start on anti-infl ammatory therapy.
Occasionally, IRIS becomes progressively worse and may require a short course of treatment with corticosteroids and, rarely, temporary discontinuation of ART. The same ART regimen should be restarted once IRIS has improved.

8.3.5 Monitoring the response to ART and the diagnosis of Treatment Failure

In addition to checking for ART side effects, a clinical assessment should be made of the child's or caregiver's adherence to therapy and the need for additional support. The frequency of clinical monitoring depends on the response to ART. At a minimum, after the start of ART, follow-up visits should be made:
For infants < 12 months, at weeks 2, 4 and 8 and then every 4 weeks for the first year

- For children > 12 months, at weeks 2, 4, 8 and 12 and then every 2–3 months once the child has stabilized on ART
- Any time there is a problem of concern to the caregiver or intercurrent illness.

Important signs of infants' and children's responses to ART include:

- Improvement in the growth in children who have been failing to grow
- Improvement in neurological symptoms and development of children with encephalopathy or who had delayed achievement of developmental milestones
- decreased frequency of infections (bacterial infections, oral thrush and other opportunistic infections)

Long-term follow-up

- A clinician should see the child at least every 3 months.
- A non-clinician (ideally, the provider of ART, such as a pharmacist) should assess adherence and provide adherence counselling.

Children who are clinically unstable should be seen more frequently, preferably by a clinician.

The organization of follow-up care depends on local expertise, and should be decentralized as much as possible.

Monitoring response at each visit

- Weight and height
- Neurodevelopment
- Adherence to treatment
- CD4 (%) count, if available (every 6 months)
- Baseline Hb or Hct (if on ZDV/AZT) and alanine aminotransferase activity, if available

Symptom-directed laboratory testing: Hb, Hct or full blood count, alanine aminotransferase activity

When to change treatment

When to substitute

If toxic effects can be associated with an identifi able drug in a regimen, it can be replaced by another drug in the same class that does not have the same adverse effect. As few antiretroviral drugs are available, drug substitutions should be limited to:

- Severe or life-threatening toxicity, such as:
- Stevens Johnson syndrome
- Severe liver toxicity
- Severe haematological effects
- Drug interaction (e.g. TB treatment with rifampicin interfering with nevirapine or protease inhibitor).
- Potential lack of adherence by the patient if he or she cannot tolerate the regimen.

When to switch

Monitoring individuals receiving ART is important to ensure successful treatment, identify adherence problems and determine whether and which ART regimens should be switched in case of treatment failure.

ART failure may be due to:

- Poor adherence
- Inadequate drug level
- Prior or treatment experienced drug resistance
- Inadequate potency of the drug
- A reasonable trial of the therapy is required before ART is determined to be failing on clinical criteria alone:
- The child should have received the regimen for at least 24 weeks.

- Adherence to therapy should be considered optimal.
- Any opportunistic infections have been treated and resolved.
- IRIS has been excluded.
- The child is receiving adequate nutrition.
- Definitions of clinical, Immunological and Virological Failure
- Clinical failure (clinical criteria): appearance or reappearance of WHO clinical stage 3 or 4 events (with the exception of TB) after at least 24 weeks on ART, with adherence to treatment
- Immunological failure (CD4 criteria): count of < 200 cells/mm3 or CD4 < 10% for a child aged < 5 years and in a child aged > 5 years persistent CD4 levels < 100 cells/mm3

Virological failure (viral load criteria): persistent viral load > 1000 RNA copies/ml after at least 24 weeks on ART, and based on two consecutive measurements within 3 months, with adherence to treatment.

When treatment failure is confirmed, switching to a second-line regimen becomes necessary.

Second-line treatment regimens

In the event of treatment failure, the entire regimen should be changed from a fi rst-line to a second-line combination. The second-line regimen should include at least three new drugs, one or more of them in a new class. Recommending potent, effective second-line regimens for infants and children is particularly difficult because of the lack of experience in use of second-line regimens in children and the limited number of formulations appropriate for children.

After failure of a first-line NNRTI-based regimen, a regimen with boosted protease inhibitor plus two NRTIs is recommended for second-line ART. LPV/RTV is the preferred boosted protease inhibitor for a second-line ART

regimen after failure of a fi rst-line NNRTI-based regimen. Recommended second-line treatment is indicated in Table 8.4 below.

Table 8.4: Recommended second-line regimen for children

	Children	First line regimen	Second line regimen
LPV/r-based first-line regimen	Younger than 3 years	ABC + 3TC + LPV/r	No change[a]
		AZT + 3TC + LPV/r	
	3 years and Older	ABC + 3TC + LPV/r	AZT + 3TC + EFV
		AZT + 3TC + LPV/r	ABC or TDF[b] + 3TC + EFV
NNRTI-based first-line regimen	All ages	ABC + 3TC + EFV (or NVP)	AZT + 3TC + LPV/rc
		TDF[b] + 3TC + EFV (or NVP)	
		AZT + 3TC + EFV (or NVP)	ABC or TDF + 3TC+ LPV/r[c]

a. *No change is recommended unless in the presence of advanced clinical disease progression or lack of adherence specifically because of poor palatability of LPV/r. In this case, switching to a second-line NVP-based regimen should be considered.*

b. *TDF may only be given to children >2 years.*

c. *ATV/r can be used as an alternative to LPV/r in children older than 6 years.*

8.4 Supportive care for HIV-positive children

8.4.1 Vaccination

HIV-exposed infants and children should receive all vaccines in the Expanded Programme for Immunization, including H. infl uenzae type B and pneumococcal vaccine, according to the national schedule. The only exception is that infants with symptomatic HIV should not receive BCG.

8.4.2 Co-trimoxazole prophylaxis

Co-trimoxazole prevents PCP in infants and reduces morbidity and mortality among infants and children living with, or exposed, to HIV. Co-trimoxazole also protects against common bacterial infections, toxoplasmosis and malaria.

Who should receive co-trimoxazole?

All infants born to HIV-infected mothers should receive co-trimoxazole 4–6 weeks after birth or at their fi rst encounter with the health care system. They should continue until HIV infection has been excluded and they are no longer at risk of acquiring HIV from breast milk.

All infected children should be continued on co-trimoxazole even when on ART.

How long co-trimoxazole should be given?

Adherence should be discussed at initiation and monitored at each visit. Cotrimoxazole must be taken as follows:

- HIV-exposed children: for the fi rst year or until HIV infection has been defi nitively ruled out and the mother is no longer breastfeeding
- When on ART: Co-trimoxazole may be stopped once clinical or immunological indicators confi rm restoration of the immune system for ≥ 6 months. It is not known whether co-trimoxazole continues to provide protection after the immune system is restored.
- Children with a history of PCP: Continue indefinitely.
- Under what circumstances co-trimoxazole should be discontinued?
- If the child develops severe cutaneous reactions such as Stevens Johnson syndrome, renal or hepatic insuffi ciency or severe haematological toxicity.

After HIV infection has confi dently been excluded in an HIV-exposed child:

- In a non-breastfed child aged < 18 months by a negative virological test

- In a breastfed child aged < 18 months by a negative virological test conducted 6 weeks after cessation of breastfeeding.
- In a breastfed child aged > 18 months by a negative HIV serological test 6 weeks after cessation of breastfeeding

In HIV-infected children, co-trimoxazole should be continued until they are 5 years of age and on ART with a sustained CD4 percentage > 25%.

Co-trimoxazole should not be discontinued if not on ART.

What doses of co-trimoxazole should be used?

Recommended dosages of 6–8 mg/kg trimethoprim once daily should be used.

Table 8.5: Co-trimoxazole (CPT) dosing for children

Age (weight)	**Co-trimoxazole (240 mg/5ml) suspension**	**Co-trimoxazole single strength tab (480 mg)**	**Co-trimoxazole double strength tab (960 mg)**
Up to 6 months (5 kg)	2.5 ml/day	½ tab/day	-
6 months to 5 yr (5-15 kg)	5 ml/day	½ tab/day	-
6-14 yr (15-30 kg)	10 ml/day	1 tab/day	½ tab/day

If the child is allergic to co-trimoxazole, dapsone is the best alternative can be given from 4 weeks of age at 2 mg/kg per day orally once daily.

What follow-up is required?

Assessment of tolerance and adherence: Co-trimoxazole prophylaxis should be a routine part of the care of HIV-infected children and be assessed at all regular clinic or follow-up visits by health workers or other members of multidisciplinary care teams. Clinical follow-up could initially be monthly, then every 3 months, if co-trimoxazole is well tolerated.

8.4.3 Nutrition

The mothers of infants and young children known to be infected with HIV are strongly encouraged to breastfeed them exclusively for 6 months and to continue breastfeeding up to the age of 1 year. Older children should eat varied, energy-rich food to increase their energy intake and to ensure adequate micronutrient intake.

Children should be assessed routinely for nutritional status, including weight and height, at scheduled visits. Their energy intake might have to be increased by 25–30% if they lose weight or grow poorly.

HIV-infected children who have severe acute malnutrition should be managed according to the guidelines for uninfected children and given 50–100% additional energy-rich foods

8.5 Management of HIV-related conditions

The treatment of most infections (such as pneumonia, diarrhoea and meningitis) in HIV-infected children is the same as in other children. In cases of treatment failure, consider giving a second-line antibiotic. Treatment of recurrent infections is the same, regardless of the number of recurrences.

Some HIV-related conditions that require specific management are described below.

8.5.1 Tuberculosis

In a child with suspected or proven HIV infection, a diagnosis of TB should always be considered, although it is often diffi cult to confi rm. Early in HIV infection, when immunity is not impaired, the signs of TB are similar to

those in a child without HIV infection. Pulmonary TB is still the commonest form of TB, even in HIV-infected children. As HIV infection progresses and immunity declines, dissemination of TB becomes more common, and tuberculous meningitis, miliary TB and widespread tuberculous lymphadenopathy occur.

HIV-infected infants and children with active TB should begin TB treatment immediately. If they are not yet started on ART, this should be started as soon as it is tolerated, within the fi rst 8 weeks of TB therapy, irrespective of CD4 count and clinical stage.
In the case of confirmed or presumptive TB, initiating TB treatment is the priority.
Any child with active TB should begin TB treatment immediately and start ART as soon as it can be tolerated but within the first 8 weeks of TB therapy.
For children on TB treatment:

- Children> 3 years and at least 10 kg, a regimen containing EFV is preferred.
- Children< 3 years of age, if the child is on a LPV/r-containing regimen, consider adding RTV in a 1:1 ratio of LPV:RTV to achieve a full therapeutic dose of LPV.
- A triple NNRTI-containing regimen may be used as an alternative.
- Treat TB in HIV-infected children with the same anti-TB drug regimen as for uninfected children with TB.

Isoniazid preventive therapy
All HIV-infected infants and children should be screened for TB infection, as they are at special risk. If a child has cough, fever or weight loss, assess for TB. If the child does not have TB, give isoniazid preventive therapy (IPT) daily for 6 months.

Give isoniazid preventive therapy to:

- All HIV-infected infants and children exposed to TB from household contacts, but with no evidence of active disease, are well and thriving.
- children > 12 months living with HIV infection, including those previously treated for TB, who are not likely to have active TB and are not known to be exposed to TB
- Give 10 mg/kg isoniazid daily for at least 6 months. See the child monthly and give a 1-month supply of isoniazid at each visit.

Note: Infants living with HIV infection who are unlikely to have active TB and are not known to have been exposed to TB should not receive isoniazid preventive therapy as part of HIV care.

8.4.2 Pneumocystis jiroveci pneumonia

PCP should be suspected in any HIV-positive infant with severe pneumonia.

If PCP is untreated, mortality from this condition is very high. It is therefore imperative to provide treatment as early as possible.

Diagnosis

- Is most likely in a child < 12 months (peak age, 4–6 months),
- Subacute or acute onset of non-productive cough and diffi culty in breathing,
- No or low-grade fever,
- Cyanosis or persistent hypoxia,
- Poor response to 48 h of fi rst-line antibiotics for pneumonia, and
- Elevated levels of lactate dehydrogenase.

Although clinical and radiological signs are not diagnostic, the presence of severe respiratory distress (tachypnoea, chest indrawing and cyanosis),

with disproportionate clear chest or diffuse signs on auscultation and low oxygen saturation are typical of PCP infection.

A chest X-ray is falsely negative in 10–20% of proven cases of PCP but typically shows a bilateral diffuse interstitial reticulogranular ('ground glass') pattern, with no hilar lymph nodes or effusion. PCP may also present with pneumothorax.

Induced sputum and nasopharyngeal aspiration are useful for obtaining sputum for examination.

Treatment

Promptly give oral or preferably IV high-dose co-trimoxazole (8 mg/kg trimethoprim–40 mg/kg sulfamethoxazole) three times a day for 3 weeks.

If the child has a severe drug reaction, change to pentamidine (4 mg/kg once a day) by IV infusion for 3 weeks. Prednisolone at 1–2 mg/kg per day for 1 week may be helpful early in the disease if severe hypoxia or severe respiratory distress is present.

Continue co-trimoxazole prophylaxis on recovery, and ensure that ART is given

8.4.3 Lymphoid interstitial pneumonitis (LIP)

Diagnosis

LIP is one of the most common chronic lower respiratory conditions occurring in up to 25% of children with HIV/AIDS.

The child is often asymptomatic in the early stages but may later have:

- Persistent cough, with or without diffi culty in breathing,

- Bilateral parotid swelling,
- Persistent generalized lymphadenopathy,
- Hepatomegaly and other signs of heart failure, and
- Finger-clubbing.
- Chest X-ray: Suspect lymphoid interstitial pneumonitis if the chest X-ray shows a bilateral reticulonodular interstitial pattern, which should be distinguished from pulmonary TB and bilateral hilar adenopathy

Treatment

Give a trial of antibiotic treatment for bacterial pneumonia before starting treatment with prednisolone.

Start treatment with steroids only if the chest X-ray shows lymphoid interstitial pneumonitis, plus any of the following signs:

- Fast or difficult breathing
- Cyanosis
- Pulse oximetry reading of oxygen saturation ≤ 90%.
- Give oral prednisolone at 1–2 mg/kg per day for 2 weeks. Then decrease the dose over 2–4 weeks, depending on the response to treatment. Beware of reactivating TB.
- Start ART if not already on treatment.

8.4.4 Fungal infections

Oral and oesophageal candidiasis

- Treat oral thrush with nystatin (100 000 U/ml) suspension. Give 1–2 ml into the mouth four times a day for 7 days. If this is not

available, apply 1% gentian violet solution. If these are ineffective, give 2% miconazole gel at 5 ml twice a day, if available.

- Suspect oesophageal candidiasis if the child has difficulty or pain while vomiting or swallowing is reluctant to take food, is salivating excessively or cries during feeding. The condition may occur with or without evidence of oral thrush.
- If oral thrush is not found, give a trial of treatment with fl uconazole. Exclude other causes of painful swallowing (such as cytomegalovirus, herpes simplex, lymphoma and, rarely, Kaposi sarcoma), if necessary by referral to a larger hospital where appropriate testing is possible.
- Give oral fl uconazole (3–6 mg/kg once a day) for 7 days, except if the child has active liver disease.
- Give amphotericin B (0.5 mg/kg once a day) by IV infusion for 10–14 days to children who don't respond to oral therapy or are unable to tolerate oral medications or risk disseminated candidiasis (e.g. a child with leukopenia).

Cryptococcal meningitis

- Suspect cryptococcus as a cause in any HIV-infected child with signs of meningitis.
- The presentation is often subacute, with chronic headache or only mental status changes. An India ink stain of CSF confi rms the diagnosis.
- Treat with amphotericin at 0.5–1.5 mg/kg per day for 14 days, then with fluconazole 6–12 mg/kg (maximum 800 mg) for 8 weeks.

- Start fluconazole 6 mg/kg daily (maximum 200 mg) prophylaxis after treatment.

8.4.5 Kaposi sarcoma

Consider Kaposi sarcoma in children presenting with nodular skin lesions, diffuse lymphadenopathy and lesions on the palate and conjunctiva with periorbital bruising. Diagnosis is usually clinical but can be confi rmed by a needle biopsy of skin lesions or lymph node. Suspect Kaposi sarcoma also in children with fungal infections, persistent diarrhoea, weight loss, intestinal obstruction, abdominal pain or large pleural effusion. Consider referral to a larger hospital for management.

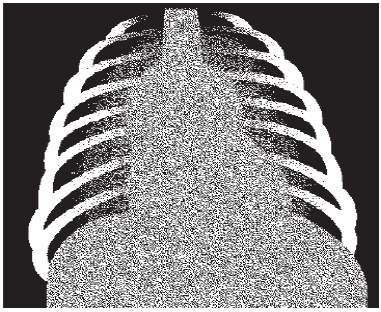


Figure 8.1 Lymphocytic interstitial pneumonia: typical hilar lymphadenopathy and lace-like infiltrates

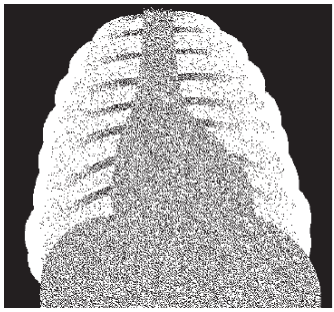


Figure 8.2 Pneumocystis jiroveci pneumonia (PCP): typical 'ground glass' Appearance

8.6 Prevention of mother-to-child HIV transmission, and infant feeding

8.6.1 Prevention of mother-to-child HIV transmission

- HIV may be transmitted during pregnancy, labour and delivery or through breastfeeding. The best way to prevent transmission is to prevent HIV infection in general, especially in pregnant women, and to prevent unintended pregnancies in HIV-positive women. If an HIV-

infected woman becomes pregnant, she should be provided with ART, safe obstetric care and counselling and support for infant feeding.

- HIV-infected pregnant women should be given ART both to benefit their own health and to prevent HIV transmission to their infants during pregnancy and breastfeeding.

- Starting lifelong ART for all pregnant women with HIV infection regardless of symptoms is referred to as Option B+

- Option B+: A Triple ARV treatment regimen for the mother beginning in pregnancy and continued for life, as well as infant prophylaxis for 6 weeks after birth, whether or not the infant is breastfeeding. Since 2013 Ethiopia has rolled out option B+ for PMTCT using combination of TDF, 3TC and EFF, which is given daily as a single pill. This strategy has greatly simplified PMTCT regimen and will also improve adherence.

8.6.2 Infant feeding in the context of HIV infection

- In the absence of any interventions, 15–25% of HIV-positive mothers will infect their infants during pregnancy or delivery; if they breastfeed, there is an additional absolute risk of 5–20%. Although avoidance of breastfeeding eliminates the risk for HIV transmission through breast milk, replacement feeds have been associated with increased infant morbidity and mortality.

- Exclusive breastfeeding during the first 6 months of life carries less risk for HIV transmission than mixed feeding, and it provides considerable protection against infectious diseases and other benefits.

ART greatly reduces the risk for HIV transmission, while simultaneously ensuring that the mother receives appropriate care to improve her own health. If an HIV-positive mother breastfeeds her infant while taking ART and gives ART to her infant each day, the risk for transmission is reduced to

2% or 4% if she breastfeeds for 6 or 12 months, respectively. It is important to:

- Support mothers known to be HIV-positive in achieving the greatest likelihood that their child will be HIV-free and survive, while taking into consideration their own health.
- Balance the prevention of HIV transmission against meeting the nutritional requirements and protection of infants against non-HIV morbidity and mortality.
- HIV-positive mothers should receive lifelong ART treatment to improve their own health, and the infant should be put on ART prophylaxis while breastfeeding.

Infant feeding advice

- Our national guideline recommends that HIV-positive mothers should breastfeed their infants exclusively for the first 6 months of life, introducing appropriate complementary foods thereafter, and should continue breastfeeding for the first 12 months of life.
- When a decision has been taken to continue breastfeeding because the child is already infected, ART treatment and infant feeding options should be discussed for future pregnancies.
- Mothers will require continued counselling and support to feed their infants optimally. Counselling should be done by a trained, experienced counsellor.
- Local people experienced in counselling should be consulted, so that the advice given is consistent. If the mother is using breast-milk substitutes, counsel her about their correct use and demonstrate safe preparation.

8.7 Follow-up

8.7.1 Discharge from hospital

HIV-infected children may respond slowly or incompletely to the usual treatment. They may have persistent fever, persistent diarrhoea and chronic cough. If the general condition of these children is good, they need not remain in hospital but can be seen regularly as outpatients.

8.7.2 Referral

If the necessary facilities are not available, consider referring a child suspected of having HIV infection:

- For HIV testing with pre- and post-test counseling
- To another centre or hospital for further investigations or second-line treatment if there has been little or no response to treatment
- To a trained counsellor for HIV and infant feeding, if the local health worker cannot do this
- To a community or home-based care programme, a community or institutionbased voluntary counselling and testing centre or a community-based social support programme for further counselling and continuing psychosocial support.
- Orphans must be referred to essential services, including health care education and birth registration.

8.7.3 Clinical follow-up

Children who are known to be HIV-infected should, when not ill, attend well-infant clinics like other children. In addition, they need regular clinical follow-up at fi rst-level facilities to monitor their:

- Clinical condition
- Growth
- Nutritional intake

- Vaccination status

They should also be given psychosocial support, if possible in community programmes

8.8 Palliative and end-of-life care

An HIV-infected, immunologically compromised child often has considerable discomfort, so good palliative care is essential. All decisions should be taken with the parents or caretaker, and the decisions should be clearly communicated to other staff (including night staff). Consider palliative care at home as an alternative to hospital care. Some treatments for pain control and relief of distressing conditions (such as oesophageal candidiasis or convulsions) can significantly improve the quality of the child's remaining life.

Give end-of-life (terminal) care if:

- The child has progressively worsening illness
- Everything possible has been done to treat the presenting illness.

Ensuring that the family has appropriate support to cope with the impending death of the child is an important part of care in the terminal stages of HIV/AIDS. Parents should be supported in their efforts to give palliative care at home so that the child is not kept in hospital unnecessarily

8.8.1 Pain control

The management of pain in HIV-infected children follows the same principles as for other chronic diseases, such as cancer and sickle-cell disease. Particular attention should be paid to ensuring that the care is culturally appropriate and sensitive. (see chapter 10)

8.8.2 Management of anorexia, nausea and vomiting

Loss of appetite during a terminal illness is diffi cult to treat. Encourage carers to continue providing meals and to try:

Giving small feeds more frequently, particularly in the morning when the child's appetite may be better

Giving cool foods rather than hot foods

Avoiding salty or spicy foods

Giving oral metoclopramide (1–2 mg/kg) every 2–4 h, if the child has distressing nausea and vomiting.

8.8.3 Prevention and treatment of pressure sores

Teach carers to turn the child at least once every 2 h. If pressure sores develop, keep them clean and dry. Use local anaesthetics such as tetracaine, adrenaline and cocaine to relieve pain.

8.8.4 Care of the mouth

Teach carers to wash out the mouth after every meal. If mouth ulcers develop, clean the mouth at least four times a day with clean water or salt solution and a clean cloth rolled into a wick. Apply 0.25% or 0.5% gentian violet to any sores. If the child has a high fever or is irritable or in pain, give paracetamol.

Crushed ice wrapped in gauze and given to the child to suck may give some relief. If the child is bottle-fed, advise the carer to use a spoon and cup instead.

If a bottle continues to be used, advise the carer to clean the teat with water before each feed.

If oral thrush develops, apply miconazole gel to the affected areas at least three times a day for 5 days, or give 1 ml nystatin suspension four times a day for 7 days, pouring it slowly into the corner of the mouth so that it reaches the affected parts.

If there is pus due to a secondary bacterial infection, apply tetracycline or chloramphenicol ointment. If there is a foul smell in the mouth, give IM benzylpenicillin (50 000 U/kg every 6 h), plus oral metronidazole suspension (7.5 mg/kg every 8 h) for 7 days.

8.8.5 Airway management

Give priority to keeping the child comfortable rather than prolonging life.

8.8.6 Psychosocial support

Helping parents and siblings through their emotional reaction towards the dying child is one of the most important aspects of care in the terminal stage of HIV disease. How this is done depends on whether care is being given at home, in hospital or in a hospice. At home, much of the support can be given by close family members, relatives and friends.

Keep up to date on how to contact local community home care programmes and HIV/AIDS counselling groups. Find out if the carers are receiving support from these groups. If not, discuss the family's attitude towards these groups and the possibility of linking the family with them.

CHAPTER 9 - COMMON SURGICAL PROBLEMS

Infants and children develop distinct surgical diseases and have special perioperative needs. This chapter provides guidelines for the supportive care of children with surgical problems and briefly describes the management of the most common surgical conditions.

9.1 Care before, during and after surgery

Good surgical care neither begins nor ends with the procedure. In most instances it is the preparation for surgery, the anaesthetic and the postoperative care that ensures a good outcome.

9.1.1 Preoperative Care

Both the child and the parents need to be prepared for the procedure and need to consent.

- Explain why the procedure is needed, the anticipated outcome and the potential risks and benefits.
- Ensure that the child is medically fit for an operation.
- Correct fluid deficits prior to emergency procedures. Restoration of urine output implies adequate volume resuscitation. Collect and measure the urine.
- Correct electrolyte deficits as appropriate.
- **Correct anemia**: Ideally, the child's hematocrit should be checked to see if it is normal for the age and population. Prepare blood for major surgical procedures. Correct iron deficiency anemia in elective surgical children with oral medications.
- Check that the child is in the best nutritional state possible. Good nutrition is needed to heal wounds.

- Check that the child has an empty stomach prior to a general anaesthesia. Infants under 12 months: the child should be given no solids orally for 8 hrs, no formula for 6 hrs, no clear liquids for 4 hrs, or no breast milk for 4 hrs before the operation. If prolonged periods of fasting are anticipated (>6 hrs) give intravenous fluids that contain glucose. Young infants may need IV fluids.

Additional preoperative lab screening is generally not essential. However, carry out the following if possible.

Infants less than 6 months: check hematocrit and do blood group and Rh status

Children 6 months–12 years: no need of investigation for minor surgery; check hematocrit for major surgery.

Preoperative antibiotics should be given for:

- Infected and contaminated cases (e.g. those requiring bowel or bladder surgery)
- Bowel: give ampicillin (25–50 mg/kg IV four times a day), gentamicin (7.5 mg/kg IV once a day) and metronidazole (7.5 mg/kg three times a day) at least 24 hrs before and for 3–5 days after the operation.
- Urinary tract: give ampicillin (25–50 mg/kg IV four times a day), and gentamicin (7.5 mg/kg IV once a day) before and for 3–5 days after the operation.

Children at risk for endocarditis (children with congenital heart disease or valvular heart disease) *undergoing dental, oral, respiratory and*

oesophageal procedures: give amoxicillin 50 mg/kg orally 1 hr before the operation or, if unable to take oral medications, ampicillin 50 mg/kg IV within 30 minutes before the surgery. If the child has penicillin allergy, consider oral clinadamycin/cefalexin /clarithromycin / azithromycin PO or IV. For GI and GU procedures, IM/IV ampicillin 50 mg/kg IV plus gentamicin 7.5 mg/kg IM or IV within 30 minutes before the surgery and IM/IV ampicillin or oral amoxicillin 6hrs later.

9.1.2 Intraoperative care

Anaesthesia

Infants and children experience pain just like adults, but may express it differently.

Make the procedure as painless as possible.

For minor procedures in co-operative children: give a local anaesthetic such as lidocaine 4–5 mg/kg or bupivacaine 0.25% (dose not to exceed 1 mg/kg).

For major procedures: give general anaesthesia

Ketamine is an excellent anaesthetic when muscle relaxation is not required.

Insert an intravenous cannula (it may be more convenient to delay this until after ketamine has been given IM).

- *Give ketamine 5–8 mg/kg IM or 1–2 mg/kg IV; following IV ketamine, the child should be ready for surgery in 2–3 minutes, if given IM in 3–5 minutes.*
- Give a further dose of ketamine (1–2 mg/kg IM or 0.5–1 mg/kg IV) if the child responds to a painful stimulus.
- At the end of the procedure turn the child into the lateral position and closely supervise the recovery possibly in an ICU.

- Special considerations
- *Airway*: The smaller diameter airway in children makes them especially susceptible to airway obstruction so they often need intubation to protect their airway during surgical procedures. Small children also have difficulty in moving heavy columns of air making adult vaporiser units unacceptable. Endotracheal tube sizes for children are given in Table 9.1.

Table 9.1 Endotracheal tube size by age

Age (years)	Tube size (mm)
Premature infant	2.5–3.0
Newborn	3.5
1	4.0
2	4.5
2–4	5.0
5	5.5
6	6
6–8	6.5
8	Cuffed 5.5
10	Cuffed 6.0

Alternatively, as a rough guide for normally nourished children more than 2 years old, use the following formula:

Internal diameter of the tube (mm) = [(Age in years) ÷ 4] + 4

- Another rough indicator of the correct tube size is the diameter of the child's little finger. Always have tubes one size bigger and smaller available. With a non-cuffed tube there should be a small air leak. Listen to the lungs with a stethoscope following intubation to ensure the breath sounds are equal on both sides.

- Hypothermia: Prevent hypothermia in the operating room by turning off the air conditioner, warming the room (aim for a temperature of >28 ° C when operating on an infant or small child) and covering exposed parts of child.

Use warmed fluids (but not too hot),

Monitor the child's temperature as frequently as possible and at the completion of the operation.

Hypoglycaemia: Infants and children are at risk for developing hypoglycaemia because of a limited ability to utilize fat and protein to synthesize glucose. Use glucose infusions during anaesthesia to help maintain blood sugar level. For most paediatric operations, other than minor ones, give Ringer's lactate plus glucose 5% (or glucose 5% with saline 0.9%) at a rate of 5 ml/kg of body weight per hour in addition to replacing the measured fluid losses.

- **Blood loss**: Children have smaller blood volumes than adults. Even small amounts of blood loss can be life threatening.
- Measure blood loss during operations as accurately as possible.
- Consider blood transfusion if blood loss exceeds 10% of blood volume (Table 9.2).
- Have blood readily available in the operating room if blood loss is anticipated.
- Monitor pulse rate and BP.

Table 9.2 Blood volume of children by age

Age	ml/kg body weight
Neonate	85–90
Children	80

Communicate to the family the outcome of the operation, problems encountered during the procedure, and the expected postoperative course.

9.1.3 Postoperative care

Immediately following surgery:

- Ensure that the child recovers safely from the anaesthesia.
- Monitor the vital signs—respiratory rate, pulse) and, if necessary, blood pressure every 15–30 minutes until stable (see Table 9.3)
- Avoid settings where high-risk children cannot be adequately monitored.
- Investigate and treat abnormal vital signs.

Table 9.3 Normal pulse rate and blood pressure in children

Age	Pulse rate (normal range)	Systolic blood pressure (normal)
0–1 year	100–160	Above 60
1–3 years	90–150	Above 70
3–6 years	80–140	Above 75

Note: normal pulse rates are 10% slower in sleeping children.

In infants and children a presence or absence of a strong central pulse is often a more useful guide to the presence or absence of shock than a blood pressure reading. Also, equally important may be assessing capillary refill if there is no cold exposure of the extremities.

Fluid management

Postoperatively, children commonly require more than maintenance fluid. Children with abdominal operations typically require 150% of baseline requirements and even larger amounts if peritonitis is present. Preferred IV fluids are Ringer's lactate with 5% glucose or normal saline with 5% glucose or half-normal saline with 5% glucose. Note that normal saline and Ringer's lactate do not contain glucose and there is risk of hypoglycaemia, and large amounts of 5% glucose contain no sodium and may lead to hyponatraemia.

Monitor fluid status closely.

- Record inputs and outputs (intravenous fluids, nasogastric drainage, urine drain outputs) every 4–6 hours.
- Urine output is the most sensitive indicator of fluid status in a child.
- Normal urine output: Infants 1–2 ml/kg/hour, children 1 ml/kg/hour.
- If urinary retention is suspected, pass a urinary catheter. This also allows for hourly measurements of urine output to be made, which can be invaluable in severely ill children. Suspect urinary retention if bladder is palpable or the child is unable to void urine.

Pain control

Have a plan for postoperative pain management.

- Mild pain: Give paracetamol (10–15 mg/kg every 4–6 hours) administered by mouth or rectally. Oral paracetamol can be given several hours prior to operation or rectally at the completion of surgery.

- Moderate to severe pain: Give intravenous narcotic analgesics (IM injections are painful). Morphine sulfate 0.05–0.1 mg/kg IV every 2–4 hours can be given if pain warrants. IV morphine is not usally

available. In this situation give morphine sulphate 0.15-0.2 mg/kg orally every 2-4 hours.

Nutrition

Many surgical conditions increase caloric needs or prevent adequate nutritional intake. Many children with surgical problems present in a debilitated state. Poor nutrition adversely affects their response to injury and delays wound healing.

- Feed children as soon as possible after surgery depending on the type of surgery.
- Provide a high calorie diet containing adequate protein and vitamin supplements.
- Consider feeding by nasogastric tube for children whose oral intake is poor.
- Monitor the child's weight.

Common postoperative problems

Tachycardia (raised pulse rate see Table 9. 3): May be caused by pain, hypovolaemia, anaemia, fever, hypoglycaemia, and infection.

Review the child's preoperative and intraoperative care.

Monitor the response to pain medication, boluses of IV fluids, dextrose, oxygen, and IV transfusions, where appropriate.

Bradycardia in a child should be considered as a sign of hypoxia until proven otherwise.

Fever: May be due to tissue injury, wound infections, atelectasis, urinary tract infections (from indwelling catheters), phlebitis (from an intravenous catheter site), or other concomitant infections (e.g. malaria).

Low urine output: May be due to hypovolaemia, urinary retention or renal failure. Low urine output is almost always due to inadequate fluid resuscitation.

Review the child's fluid record.

If hypovolaemia is suspected; give normal saline (10–20 ml/kg) and repeat as needed

If urinary retention is suspected (the child is uncomfortable and has a full bladder on physical examination): pass a urinary catheter

9.2 Congenital anomalies

9.2.1 Cleft lip and palate

These may occur together or separately (see figure). Reassure the parents that the problem can be dealt with, as there may be concern about the unattractive appearance.

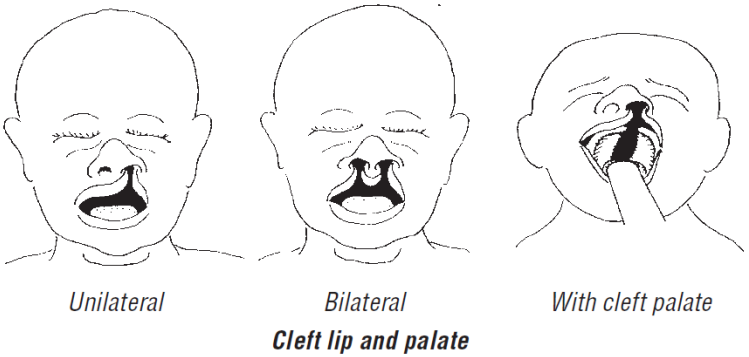


Figure 9.1: Cleft lip and palate

Treatment

Babies with isolated cleft lip can feed normally. Cleft palate is associated with feeding difficulties. The baby is able to swallow normally but unable to

suck adequately and milk regurgitates through the nose and may be aspirated into the lungs.

- Feed using expressed breast milk via a cup and spoon, or if available AND adequate sterility of bottles can be ensured, a special teat may be used. The technique of feeding is to deliver a bolus of milk over the back of the tongue into the pharynx by means of a spoon, pipette, or some other pouring device. The baby will then swallow normally.
- Close follow-up in infancy is required to monitor feeding and growth.
- Surgical closure of the lip is performed at 3 months of age (may be revised at 4-5 years of age) and of the palate is performed around 1 year of age.
- Follow-up after surgery to monitor hearing (middle-ear infections are common) and speech development.

9.2.2 GI obstruction

Hypertrophic pyloric stenosis, bowel atresia, malrotation with volvulus, meconium plug syndrome, Hirschsprung's disease (colonic aganglionosis), or imperforate anus are the common causes of bowel obstruction.

Diagnosis

The level of obstruction determines the clinical presentation. Proximal obstruction: vomiting with minimal distension. Distal obstruction: distension with vomiting occurring late.

Bile-stained (green) vomiting in an infant is due to a bowel obstruction until proven otherwise and is a surgical emergency.

Pyloric stenosis presents as progressive, projectile (forceful) non-bilious vomiting. Dehydration, weight loss, and failure to thrive can develop later. Typically occurs between 3 and 6 weeks of age.

Dehydration and electrolyte abnormalities are common

An olive like mass (the enlarged pylorus) may be palpated in the right upper abdomen

Consider other causes of abdominal distension (such as ileus related to sepsis, necrotizing enterocolitis and ascites)

Investigation: plain film of the abdomen, abdominal ultrasound if available.

Treatment

Prompt resuscitation and URGENT REVIEW by a surgeon experienced in paediatric surgery.

Give nothing orally. Pass a nasogastric tube if there is vomiting or abdominal distension.

- Intravenous fluid: use 0.45-0.9% saline + 5-10% glucose (dextrose)+ KCL 30-50Meq/L after ensuring good urine output (in case of IHPS)
- Give 10–20 ml/kg to correct dehydration
- Then give maintenance fluid plus the same volume that comes out of the nasogastric tube
- Antibiotics prophylaxis depending on the procedure

9.2.3 Abdominal wall defects

The abdominal wall does not fully develop and remains open.

Diagnosis

There may be exposed bowel (gastroschisis) or a thin layer covering the bowel (omphalocele) (see figure).

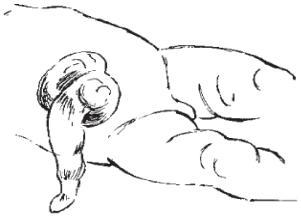


Figure 9.2: Newborn with an omphalocele

Treatment

- Apply a sterile dressing and cover with a plastic bag (to prevent fluid loss). Exposed bowel can lead to rapid fluid loss and hypothermia.
- Give nothing orally. Pass a nasogastric tube for free drainage.
- Give intravenous fluids: use normal saline + glucose (dextrose):
- Give 10–20 ml/kg to correct dehydration.
- Then give maintenance fluid requirements (chapter 10) plus the same volume that comes out of the nasogastric tube.
- Antibiotics (section 9.1.1)
- URGENT REVIEW by a surgeon experienced in paediatric surgery.

9.2.3 Myelomeningocele

Diagnosis

- A sac containing meninges and a malformed spinal cord that protrudes through defective vertebrae. The most common site is the lumbar region.
- Maybe associated with neurological problems (bowel, bladder and motor deficits in the lower extremities) and hydrocephalus.

- Maternal oral folic acid supplementation prior to conception and throughout the first trimester reduces the risk of myelomenigocele by 50% to 70%.
- There is high risk of recurrence in the family than in the general population.

Treatment

- Apply a sterile dressing.
- If ruptured, and any signs of infection give ampicillin (25–50 mg/kg IV four times a day) plus gentamicin (7.5 mg/kg once per day) for 10-14 days.
- Catheterize regularly to prevent pyelonephritis and hydronephrosis.
- REVIEW by a sergeon experienced in paediatric surgery.



Figure 9.3: Myelomeningocele

Developmental Dyspalsia of the Hip
(DDH)

Diagnosis

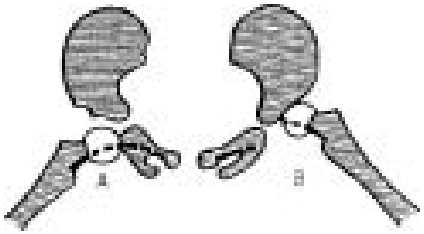
- Severe cases should be detected by routine physical examination at birth.

- When unilateral, the limb is short, there is limited abduction when the hip is flexed, and the skin crease at the back of the hip appears asymmetrical. When the flexed hip is abducted, a clunk (not an

audible click) can often be felt as the dislocated femoral head enters the acetabulum (Ortolani's sign).

- In the older infant, confirm the diagnosis with X-ray. X-rays in neonates are difficult to interpret as the epiphysis of the femur and the femoral head do not appear until 3–4 months of age (see figure), so ultrasound of the hip can be done earlier usually at 3 weeks of life if this is available. Positioning the lower limb in 45° abduction demonstrates a break in the continuity of a line drawn along the upper margin of the obturator foramen and lower aspect of the femoral neck.The figure below shows: A) Normal Shenton's line, B) The line is broken in dislocation of the hip.

B



A

Figure 9.4: Radiological diagnosis of congenital dislocation of the hip

Treatment

In milder cases, keep the hip in flexion and abduction through double nappies or an abduction brace in an abducted position for 2–3 months. In more severe cases, keep the hip abducted and flexed in a splint.

REVIEW by a surgeon experienced in paediatric orthopedics.

9.2.4 Talipes equinovarus (club foot)

Diagnosis

The foot cannot be placed into the normal position.

The commonest form is congenital form and accounts for 75% of case. In 50 % of cases it occurs bilaterally. It includes three deformities: hind foot equinus, hind and mid foot varus, fore foot adduction.

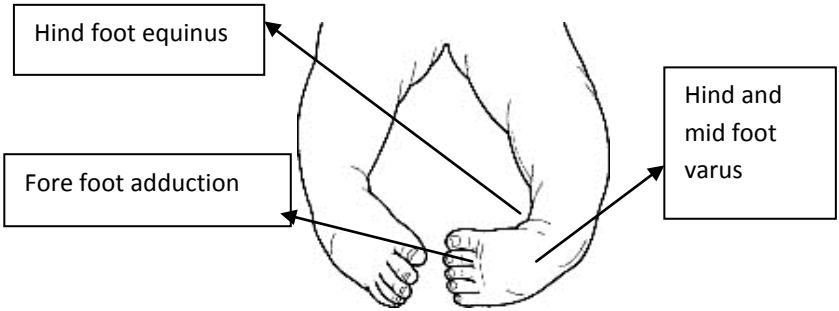


Figure 9.5: Club foot

Treatment

Non operative

- Mild positional deformity (the foot can be passively corrected): simple Stretching of foot beginning shortly after birth
- Moderate deformity: serial manipulations beginning shortly after birth
- Maintain position with tape strapping or well-padded plaster of
- Paris casts. Apply this in the sequence 1, then 2, then 3 as in Figure below.
- These manipulations should be repeated every 2 weeks or until the deformity is corrected.
- Special splints may need to be worn until the child begins to walk.

Operative:

- If cast fails, surgery is indicated at 6-12 months of age.
- If child presents beyond 3 months of age

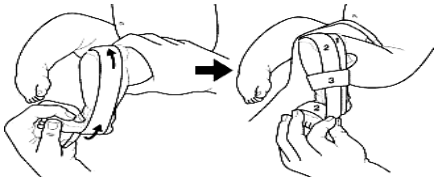


Figure 9.5: Treating talipes with tape strapping

9.3 Injuries

Injuries are the most common surgical problems affecting children. Proper treatment can prevent death and lifelong disability. Whenever possible, try to prevent childhood injuries from occurring.

See Chapter 1 for guidelines for assessing children with severe injuries. More detailed surgical guidance is given in the WHO manual of surgical care in the district hospital.

9.3.1 Burns

Burns are associated with a high risk of mortality in children. Those who survive may suffer from disfigurement and psychological trauma as a result of a painful and prolonged stay in the hospital.

Assessment

Burns may be partial or full thickness. A full thickness burn means the entire thickness of the skin is destroyed, and the skin will not regenerate.

Ask two questions:

How deep is the burn?

- Full thickness burns are black or white, usually dry, have no feeling and do not blanch on pressure.
- Partial thickness burns are pink or red, blistering or weeping, and painful.

How much of the body is burnt?

- Use a body surface area chart according to age
- Alternatively, use the child's palm to estimate the burn area. A child's palm is approximately 1% of the total body surface area.

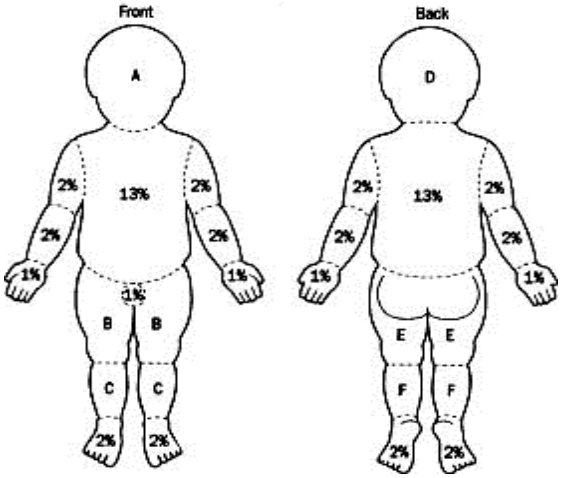


Figure 9.10.Estimation of the total area burned in percentage

Table 9.4 Tools for estimating the percentage of body surface burned

IN Areas A-F the percentage changes according to the age of the child				
Area	% By age in years			
	0	1	5	10
Head (A/D)	10%	9%	7%	6%
Thigh (B/E)	3%	3%	4%	5%
Leg (C/F)	2%	3%	3%	3%

Treatment

- Admit all children with burns >10% of their body surface; those involving the face, neck, hands, feet, perineum, across joints, high tension electrical burns; burns that are circumferential and those that cannot be managed as outpatients.

- Consider whether the child has a respiratory injury due to smoke inhalation.
- If there is evidence of respiratory distress, then provide supplemental oxygen
- Severe facial burns and inhalational injuries may require early intubation or tracheostomy to prevent or treat airway obstruction.
- Fluid resuscitation (required for >10% total body surface burn). Use Ringer's lactate with 5% glucose, normal saline with 5% glucose or half-normal saline with 5% glucose.

1st 24 hours: Calculate fluid requirements by adding maintenance fluid requirements and additional resuscitation fluid requirements (volume equal to 4 ml/kg for every 1% of surface burned) (Section 10.2)

Administer 1/2 of total fluid in first 8 hours, and remaining in next 16 hours.
Example: 20 kg child with a 25% burn:
Total fluid in 1st 24 hrs = (1500ml) + 4 ml x 20kg x 25% burn
= 1500 ml + 2000 ml
= 3500 ml (1750 ml over 1st 8 hours)

Second 24 hours: give 1/2 to 3/4 of fluid required during the first day.

Monitor the child closely during resuscitation (pulse, respiratory rate, blood pressure and urine output).

Blood may be given to correct severe anemia or for deep burns to replace blood loss.

Prevent infection

- If skin is intact, clean with antiseptic solution gently without breaking the skin

- If skin is not intact, carefully debride the burn. Blisters should be pricked and dead skin removed.
- Give topical antibiotics/antiseptics (there are several options depending on resources available and these include: silver nitrate, silver sulfadiazine, gentian violet, betadine and even mashed papaya). Clean and dress the wound daily.
- Small burns or those in areas that are difficult to cover can be managed by leaving them open to the air and keeping them clean and dry.
- Oral or IV penicillin for 5 days (standard dose QID)
- Treat secondary infection if present.
- If septicaemia is suspected, use gentamicin (7.5 mg/kg IM or IV once a day) plus cloxacillin (25–50 mg/kg IM or IV four times a day). If infection is suspected beneath an eschar, remove the eschar.

Pain control (see chapter 10)

- Make sure that pain control is adequate including before procedures such as changing dressings.
- Give paracetamol (10–15 mg/kg every 6 hours) by mouth or
- If pain is severe can give Morphin syrup or intravenous narcotic analgesics (IM injections are painful), such as morphine sulfate (0.05–0.1 mg/kg IV every 2–4 hours)
- Check tetanus vaccination status and treat as per Table 9.5.

Table 9.5 Indications for Tetanus prophylaxis

Prior Tetanus Toxoid doses	TT/DPT	TAT/TIG
Unknown/<3	Yes	Yes
≥3, last <5yrs ago	No	No
≥3, last >5yrs ago	Yes	No

Nutrition

- Begin feeding as soon as practical in the first 24 hours.
- Children should receive a high calorie diet containing adequate protein, and vitamin and iron supplements.
- Children with extensive burns require about 1.5 times the normal calorie and 2–3 times the normal protein requirements.

Burn contractures: Burn scars across flexor surfaces contract. This happens even with the best treatment.

Prevent contractures by passive mobilization of the involved areas and by splinting flexor surfaces. Splints can be made of plaster of Paris. Splints should be worn at night.

Physiotherapy and rehabilitation

- Should begin early and continue throughout the course of the burn care.
- If the child is admitted for a prolonged period, ensure the child has access to toys and is encouraged to play.

9.3.2 Principles of wound care

The goal of caring for any wound is to stop bleeding, prevent infection, assess damage to underlying structures and promote wound healing.

Stop bleeding

- Direct pressure will control any bleeding.

- Bleeding from extremities can be controlled for short periods of time (<10 minutes) using a sphygmomanometer cuff inflated above the arterial pressure.
- Prolonged use of tourniquets can damage the extremity. Never use a tourniquet in a child with sickle-cell anemia.

Prevent infection

- Cleaning the wound is the most important factor in preventing a wound infection. Most wounds are contaminated when first seen. May contain blood clots, dirt, dead or dying tissue and perhaps foreign bodies.
- Clean the skin around the wound thoroughly with soap and water or antiseptic. Water and antiseptic should be poured into the wound.
- After giving a local anaesthetic such as bupivacaine 0.25% (not to exceed 1ml/kg), search carefully for foreign bodies and carefully excise any dead tissue. Determine what damage may have been done. Major wounds require a general anaesthetic.

Antibiotics are usually not necessary when wounds are carefully cleaned. However, there are some wounds that should be treated with antibiotics (see below).

- Wounds older than 12 hours
- Wounds penetrating deep into tissue (e.g. a dirty stick or knife wound).

Tetanus prophylaxis

See table 9.5 above

Wound closure

- If the wound is less than 6 hrs old and has been cleaned satisfactorily, the wound can be closed (called primary closure).

- The wound should not be closed if it is more than 6 hours old, there has been a lot of dirt and foreign material in the wound, or if the wound has been caused by an animal bite including human bite
- Wounds not treated with primary closure should be packed lightly with damp gauze. If the wound is clean 48 hours later, the wound can then be closed (delayed primary closure).
- If the wound is infected, pack the wound lightly and let it heal on its own.

Wound infections

Clinical signs: pain, swelling, redness, warmth and pus drainage from the wound.

Treatment

- Open wound if pus suspected
- Clean the wound with disinfectant.
- Pack the wound lightly with damp gauze. Change the dressing every day, more frequently if needed.

Antibiotics until surrounding cellulitis has resolved (usually 5 days):

- Give cloxacillin (25–50 mg/kg orally four times a day) for most wounds to deal with Staphylococcus.
- Give ampicillin (25–50 mg/kg orally four times a day), gentamicin (7.5 mg/kg IM or IV once a day) and metronidazole (7.5 mg/kg three times a day) if bowel flora is suspected.

Controlling external bleeding

Elevate the limb, apply direct pressure then put a pressure bandage

9.3.3 Fractures

Children have a remarkable ability to heal fractures if the bones are aligned properly.

Diagnosis

Pain, swelling, deformity, crepitus, unnatural movement, and loss of function.

Fractures can be closed (where the skin is intact) or open (where there is a wound of the skin). Open fractures may lead to serious bone infection. Suspect an open fracture if there is an associated wound. A child's bones are different from adults; instead of breaking they often bend like a stick

X-ray-to locate and know the extent of fracture

Treatment

Ask two questions: - Is there a fracture? - Which bone is broken (either by clinical exam or X-ray)?

Consider referral for REVIEW by a surgeon experienced in paediatric orthopedics for complicated fractures such as those that are displaced or involve growth plates or are open.

Open fractures require antibiotics: cloxacillin (25–50 mg/kg orally four times a day), and gentamicin (7.5 mg/kg IM or IV once a day) and meticulous cleaning to prevent osteomyelitis).

Figures shown below describe simple methods for treating some of the most common childhood fractures. For further details of how to manage these fractures, consult the WHO manual of surgical care at the district hospital or a standard textbook of (surgical) paediatrics.

A posterior splint can be used for upper and lower extremity injuries. The extremity is first wrapped with soft padding (e.g. cotton), then a plaster of Paris splint is placed to maintain the extremity in a neutral position. The posterior splint is held in place with an elastic bandage. Monitor the fingers

(capillary refill and temperature) to ensure the splint has not been placed too tightly.

The treatment of a mid-shaft femoral fracture in a child under 3 years of age is by gallows splint and is shown in the figure. It is important that every few hours the attendant should check that the circulation of the feet is good and the toes are warm.

The treatment of a mid-shaft femoral fracture in an older child is by skin traction. This is a simple and effective method for treating femur fractures in children aged 3–15 years. If the child can raise his leg off the bed the fracture has united and the child is ready for ambulation on crutches (usually about 3 weeks).

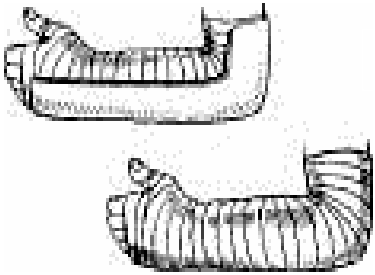


Figure 9.12 Posterior splint

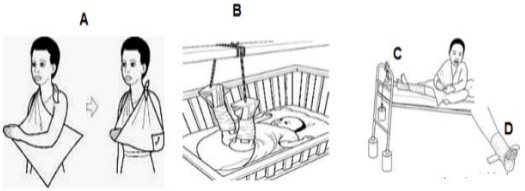


Figure 9.13: Sling and Tractions

Figure 9.13
A.Sling supporting injured arm B. Gallow Traction C.Skin Traction D.prevention of rotation deformity by adding piece of wood to foot plaster

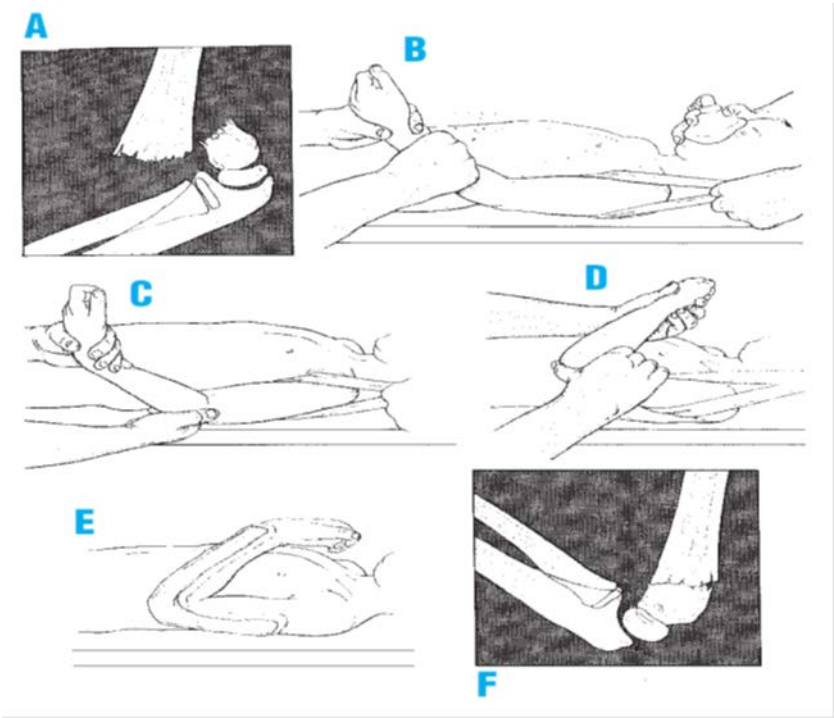


Figure 9.14: Treatment of a supracondylar fracture

A. X-ray of displaced supracondylar fracture

B. Pull as shown to reduce the fracture displacement.

C. Carefully bend the elbow maintaining traction. Hold the elbow flexed and keep the fracture in position as shown

D. Apply a back slab

E. Check the position of the fracture on X-ray.

An important complication of this fracture is constriction of the artery at the elbow—where it can become entrapped. Assess the blood flow to the hand. If the artery is obstructed the hand will be cool, capillary refill will be slow and the radial pulse will be absent. If the artery is obstructed, reduction needs to be done urgently.

9.3.4 Head injuries

Brain injuries fall into four categories (3 C's +L).

- Concussion: the mildest injury where loss of brain function is temporary.
- Contusion: the brain is bruised and function may be affected for hours to days, or even weeks.
- Compression: may result from swelling or a growing blood clot (epidural or subdural haematoma). If compression is due to a blood clot, urgent operation may be required.
- Laceration: visible cut to the brain tissue

Diagnosis

- History of head trauma.
- Diminished level of consciousness, confusion, seizure and signs of increased intracranial pressure (increased BP, drop in pulse, unequal pupils, rigid posture, focal paralysis and irregular breathing).
- Skull X-ray

Treatment

- Give nothing orally
- Protect the child's airway (see Chapter 1).
- Limit fluid intake (to 2/3 of maintenance fluid requirements
- Elevate the head of the bed to 30 degrees.
- Diagnose and treat other injuries.

- URGENT REVIEW by a surgeon experienced in paediatric surgery.

9.3.5 Chest and abdominal injuries

These can be life threatening and may result from blunt or penetrating injuries. Types of injuries include:

- Chest injuries include rib fractures, pulmonary contusions, pneumothorax and haemothorax. Because the ribcage of children is more pliable than that of adults, there may be extensive chest injuries without rib fractures.
- Blunt and penetrating trauma to the abdomen may injure a variety of organs. Splenic injuries from blunt trauma are especially common.
- Assume that a penetrating wound to the abdominal wall has entered the abdominal cavity and that there may be injuries to the intra-abdominal organs.
- Be especially cautious with injuries around the anus—as penetrating rectal injuries can be easily missed.

Treatment

Suspected chest or abdominal injuries require URGENT REVIEW by a surgeon experienced in paediatric surgery.

See guidelines given in Chapter 1.

9.4 Abdominal problems

9.4.1 Abdominal pain

Abdominal pain lasting longer than four hours should be regarded as a potential abdominal emergency.

Assessment

Ask three questions:

- Are there associated symptoms? The presence of nausea, vomiting, diarrhoea, constipation, fever, cough, headache, sore throat or dysuria (pain on passing urine) helps determine the severity of the problem and can help narrow the diagnosis.
- Where does it hurt? Ask the child to point to where it hurts most. This can also help narrow the diagnosis. Periumbilical pain is a nonspecific finding.
- Does the child have peritonitis: inflammation of the lining of the peritoneal cavity? This is a critical question, as most causes of peritonitis in children require operation.
- Signs of peritonitis include tenderness during palpation, pain in the abdomen when the child jumps or has his pelvis shaken and involuntary guarding (spasm of the abdominal musculature following palpation). A rigid abdomen that does not move with respiration is another sign of peritonitis.

Treatment

- Give the child nothing orally.
- If vomiting or abdominal distension, place a nasogastric tube.
- Give intravenous fluids (most children presenting with abdominal pain are dehydrated) to correct fluid deficits (Ringers lactate 10–20 ml/kg repeated as needed) followed by 150% maintenance fluid requirements. Add glucose 5-10% for the maintenance fluid.
- Give analgesics if the pain is severe (this will not mask a serious intra-abdominal problem, and may even facilitate a better examination).
- Repeat the examinations if the diagnosis is in question.
- Give antibiotics if there are signs of peritonitis. To deal with enteric flora (Gram-negative rods, Enterococcus, and anaerobes): give

ampicillin (25–50 mg/kg IV four times a day), gentamicin (7.5 mg/kg IV once a day) and metronidazole (7.5 mg/kg three times a day).

- URGENT REVIEW by a surgeon experienced in paediatric surgery.

9.4.2 Appendicitis

This is caused by obstruction of the lumen of the appendix. Fecoliths, lymphoid hyperplasia and gastrointestinal parasites can cause obstruction. If not recognized the appendix ruptures leading to peritonitis and abscess formation.

Diagnosis

Clinical:

- Fever, anorexia, vomiting (variable)
- May begin as periumbilical pain, but the most important clinical finding is persistent pain and tenderness in the right lower quadrant.
- May be confused with urinary tract infections, kidney stones, ovarian problems, mesenteric adenitis, and ileitis.

Lab:

- Nonspecific
- WBC count may be normal or mildly elevated
- U/A frequently demonstrates a few white or red blood cells

Treatment

- Give the child nothing orally.
- Give intravenous fluids. See above
- Give antibiotics in patients (with suspected perforation) once diagnosis established: see above

- URGENT REVIEW by a surgeon experienced in paediatric surgery. Appendectomy should be done as soon as possible to prevent perforation, peritonitis and abscess formation.

9.5 Bowel obstruction beyond the newborn period

This may be caused by incarcerated hernias, adhesions (scarring from previous surgery), Ascaris infection, and intussusception (see next section).

Diagnosis

Clinical:

- Clinical presentation is determined by the level of obstruction. Proximal obstruction—presents with vomiting with minimal distension. Distal obstruction—presents with distension, obstipation with vomiting occurring later.
- Typically there is cramping abdominal pain, distension and no flatus.
- Sometimes peristalsis waves can be seen through abdominal wall.

Investigation:

- Plain film of the abdomen shows distended loops of bowel with air fluid levels.
- Ultra sound – transverse image doughnut or target appearance

Treatment

- Give the child nothing orally
- Give fluid resuscitation. See above
- Pass a nasogastric tube—this relieves nausea and vomiting, and prevents bowel perforation by keeping the bowel decompressed.
- URGENT REVIEW by a surgeon experienced in paediatric surgery.

9.5.1 Intussusceptions

This is form of bowel obstruction in which one segment of the intestine (a proximal segment of bowel) telescopes into the next (distal portion of intestine). This most commonly occurs at the ileal-caecal junction.

Diagnosis

Usually occurs in children between 3 months to 6 years, and 80% occurs in <2 years.

Clinical presentation

- Early: colicky abdominal pain with vomiting. The child cries with pain, doubles over, and pulls the legs up.
- Late: pallor, abdominal distension, tenderness, bloody diarrhoea ("red currant jelly stool") and dehydration.
- Palpable abdominal mass most often in the right upper quadrant (begins in right lower quadrant and may extend along the line of colon).
- Barium Enema: see below

Treatment

Give an air or barium enema if gangrene is excluded (this can both diagnose and reduce the intussusception). An unlubricated 35 ml Foley catheter is passed into the rectum; the bag is inflated and the buttocks strapped together. A warm solution of barium in normal saline is allowed to flow in under gravity from a height of 1 meter and its entrance into the colon is observed using an abdominal X-ray. The diagnosis is confirmed when the barium outlines a concave 'meniscus'. The pressure of the column of barium slowly reduces the intussusception; the reduction is only complete when several loops of small bowel are seen to fill with barium.

- Pass a nasogastric tube.

- Give fluid resuscitation.
- Give antibiotics if there are signs of infection (fever, peritonitis)—give ampicillin (25–50 mg/kg IV four times a day), gentamicin (7.5 mg/kg IV once a day) and metronidazole (7.5 mg/kg three times a day). The duration of the post-operative antibiotics depends on the severity of the disease: in an uncomplicated intussusception reduced with an air enema, give for 24–48 hours postoperatively; in a child with a perforated bowel with resection, continue antibiotics for one week.
- Arrange URGENT REVIEW by a surgeon experienced in paediatric surgery. Proceed to an operation if air or barium enema is unable to reduce the intussusception. If the bowel is ischaemic or dead, then a bowel resection will be required.

9.5.2 Umbilical hernia

Diagnosis

Soft reducible swelling at umbilicus.

Treatment

- Most close spontaneously.
- Repair if not closed by age 6 years, or if there is a history of the hernia being difficult to reduce.

9.5.3 Inguinal hernia

Diagnosis

- Intermittent reducible swelling in the groin that is observed when the child is crying or straining.
- Occurs where the spermatic cord exits the abdomen (inguinal canal).

- Distinguish from a hydrocele (fluid that collects around testicle due to a patent processus vaginalis). Hydroceles trans-illuminate and usually do not extend up into the inguinal canal.
- Can also occur rarely in girls.

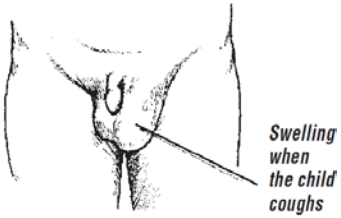


Fig 9.15: Inguinal hernia

Treatment

Uncomplicated inguinal hernia: elective surgical repair to prevent incarceration.

Hydrocele: repair if not resolved by age 1 year. Unrepaired hydroceles will lead to inguinal hernias.

Incarcerated hernias

These occur when the bowel or other intra-abdominal structure (e.g. omentum) is trapped in the hernia.

Diagnosis

- Non-reducible tender swelling at the site of an inguinal or umbilical hernia.
- There may be signs of intestinal obstruction (vomiting and abdominal distension) if the bowel is trapped in the hernia.

Treatment

- Attempt to reduce by steady constant pressure. If the hernia does not reduce easily, an operation will be required.

- Give the child nothing orally.
- Give intravenous fluids.
- Pass a nasogastric tube if there is vomiting or abdominal distension.
- Give antibiotics if compromised bowel is suspected: give ampicillin (25–50 mg/kg IV four times a day), gentamicin (7.5 mg/kg IV once a day) and metronidazole (7.5 mg/kg three times a day).
- URGENT REVIEW by a surgeon experienced in paediatric surgery.

9.5.4 Rectal prolapse

This is caused by straining during a bowel motion and is associated with chronic diarrhoea and malnutrition. Causative factors include gastrointestinal parasites (such as Trichuris)

Diagnosis

- The prolapse occurs on defecation. Initially the prolapsed section reduces spontaneously, but later may require manual reduction.
- May be complicated by bleeding or even strangulation with gangrene

Treatment

- Provided that the prolapsed rectum is not dead (it is pink or red and bleeds), reduce with gentle constant pressure.
- Firm strapping across buttocks to maintain the reduction.
- Correct underlying cause of diarrhoea and malnutrition.
- Treat for a helminth infection (such as mebendazole 100 mg orally twice a day for 3 days or 500 mg once only).
- REVIEW by a surgeon experienced in paediatric surgery. Recurrent prolapse may require a Thirsch stitch.

9.6 Infections requiring surgery

9.6.1 Abscess

Infection can cause a collection of pus in almost any area of the body.

Diagnosis

Fever, swelling, tenderness, and fluctuant mass.

Question what might be the cause of the abscess (e.g., injection, foreign body or underlying bone infection). Injection abscesses usually develop 2–3 weeks after injection.

Treatment

- Incision and drainage
- Large abscesses may require general anaesthesia.
- Antibiotics: cloxacillin (25–50 mg/kg four times a day) for 5 days or until surrounding cellulitis resolved. If bowel flora is suspected (e.g., perirectal abscess): give ampicillin (25–50 mg/kg IV four times a day), gentamicin (7.5 mg/kg IV once a day) and metronidazole (7.5 mg/kg three times a day).

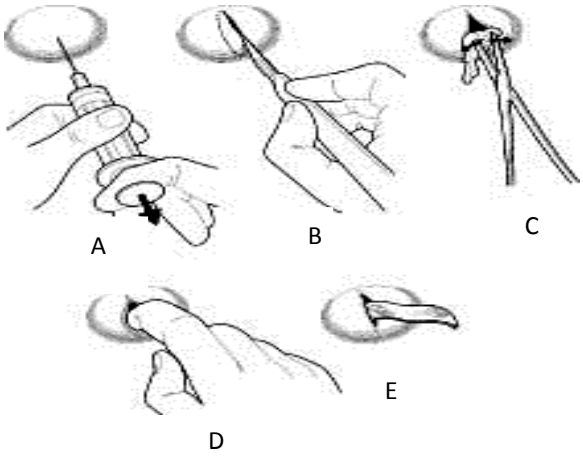


Figure 9.16: Incision and drainage of an abscess

A. Aspirating to identify site of pus; B. Elliptical incision; C–D. Breaking up loculations; E. Loose packing in place.

9.6.2 Osteomyelitis

Infection of a bone usually results from blood spread. It may be caused by open fractures. The most common organisms include Staphylococcus, H. influenza type b, Salmonella (sickle-cell children) and Mycobacterium tuberculosis.

Diagnosis

Acute osteomyelitis

Clinical:

- Pain and tenderness of the involved bone (± fever).
- Refusal to move the affected limb.
- Refusal to bear weight on leg.

Investigation:

CBC, ESR, CRP

- X ray: In early osteomyelitis the X-ray may be normal (it usually takes 12–14 days for X-ray changes to appear).
- Chronic osteomyelitis
- *Chronic draining sinuses over the involved bone.*
- *X-ray*: elevated periosteum and sequestrum (collection of dead bone).

Treatment

- REVIEW by a surgeon experienced in paediatric orthopedics
- Less than 5 years of age ceftriaxone 100 mg/kg/day in two divided doses

- Cloxacillin (100 mg/kg in four divided doses) is given for children above 5 years of age. Total duration of treatment extends from 3-6 weeks depending on the etiologies. Chronic osteomyelitis: sequestrectomy (removal of dead bone) is usually necessary as well as antibiotic treatment, as above.

9.6.3 Septic arthritis

The most common organism is Staphylococcus aureus, H. influenza type b, and streptococcus.

Diagnosis

Clinical:

- *Pain and swelling of the joint (± fever).*
- *E*xamination of the joint shows two important physical signs:
- Swelling and tenderness over the joint.
- Decreased range of movement.
- Investigation: CBC, ESR, CRP, X ray, Synovial fluid analysis, culture and sensitivity
- DDx: always exclude hemophilia in a male child

Treatment

- URGENT REVIEW by a surgeon experienced in paediatric surgery for washout of the joint. Pus under pressure in a joint destroys the joint.
- Less than 5 years of age: ceftriaxone 100 mg/kg/day in two devided doses three weeks.
- Cloxacillin (100 mg/kg in four divided doses) is given for children above 5 years of age. Total duration of treatment 3 weeks depending on the etiologies.

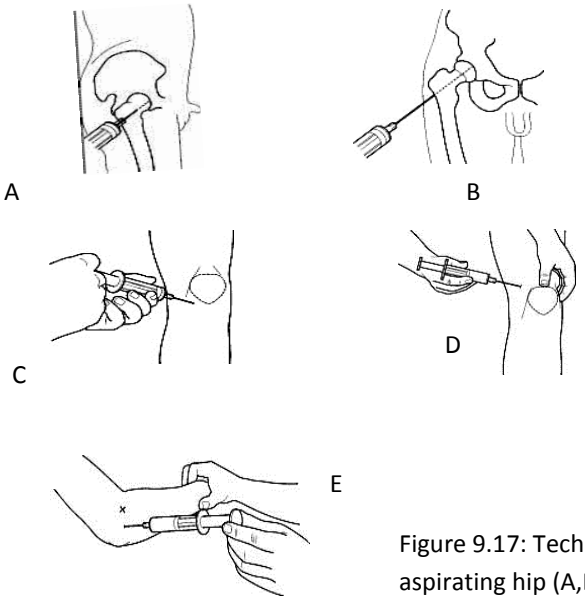


Figure 9.17: Technique for aspirating hip (A,B), knee (C,D) and elbow (E) joints.

9.6.4 Pyomyositis

This is a condition where there is pus within the substance of a muscle.

Diagnosis

Fever, tenderness and swelling of the involved muscle. A fluctuant mass may not be a sign as the inflammation is deep in the muscle.

Commonly occurs in the thigh.

Treatment

- Incision and drainage (usually requires a general anaesthetic).
- Leave a drain in the abscess cavity for 2–3 days.
- X-ray to exclude underlying osteomyelitis.
- Give cloxacillin (50 mg/kg IM or IV four times a day) for 5–10 days as the most common organism is Staphylococcus aureus.

CHAPTER 10 - SUPPORTIVE CARE

In order to provide good patient care, hospital policies and working practices should promote the basic principles of child care, such as:

- Communicating with the parents/child
- Arranging the paediatric ward so that the most seriously ill children get the closest attention and are close to oxygen and other emergency treatments
- Keeping the child comfortable
- Preventing the spread of nosocomial infection by encouraging staff to handwash regularly, and other infection prevention measures
- Keeping warm the area in which young infants or children with severe malnutrition are being looked after, in order to prevent complications like hypothermia.

10.1 Nutritional management

The health worker should follow the counseling process outlined in chapter 12. A mother's card containing a pictorial representation of the advice should be given to the mother to take home as a reminder

10.2 Supporting breastfeeding

Breastfeeding is most important for the protection of infants from illness and for their recovery from illness. It provides the nutrients needed for a return to good health. The national infant and young child feeding recommendation follows the global strategy on infant and young child feeding recommendations irrespective of HIV status of the mother and child.

- Exclusive Brest Feeding (EBF) for the first 6 months

- Initiation of complementary feeding at 6 months with continuation of breastfeeding until two years and beyond.

Health workers treating sick young children have a responsibility to encourage mothers to breastfeed and to help them overcome any difficulties. Additional national recommendation is that every facility that provides antenatal, maternity and care for newborns should:

1. Have a written breastfeeding policy that is routinely communicated to all healthcare staff.
2. Train all healthcare staff in the skills necessary to implement this policy.
3. Inform all pregnant women about the benefits and management of breastfeeding
4. Help mothers initiate breastfeeding within half an hour of birth.
5. Show mothers how to breastfeed and how to maintain lactation even if they are separated from their infants.
6. Give newborns no food or drink other than breast milk unless medically indicated.
7. Encourage rooming in—this is a hospital arrangement where the mother and baby stay in the same room day and night.
8. Encourage breastfeeding on-demand
9. Give no artificial feeds or pacifiers to breastfeeding babies.
10. The key to best breastfeeding practices is continued day-to-day support for the breastfeeding mother within her home and community.

Steps for promoting breast feeding

Assessing a breastfeed

Take a breastfeeding history by asking about the baby's feeding and behavior. Observe the mother while breastfeeding to decide whether she needs help. Observe:

- How the mother holds her baby.
- Baby should be held close to the mother.
- Baby should face the breast.
- Baby's body should be in a straight line with the head.
- Baby's whole body should be supported.

How the baby is attached to the breast. Signs of good attachment are:

- More areola visible above baby's mouth
- Mouth wide open
- Lower lip turned out
- Baby's chin touching the breast.
- How the mother holds her breast.

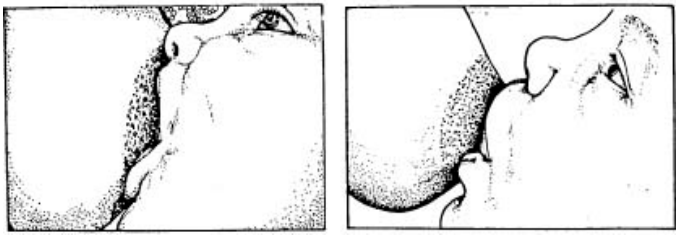


Figure 10.1 Good (left) and poor (right) attachment of infant to the mother's breast

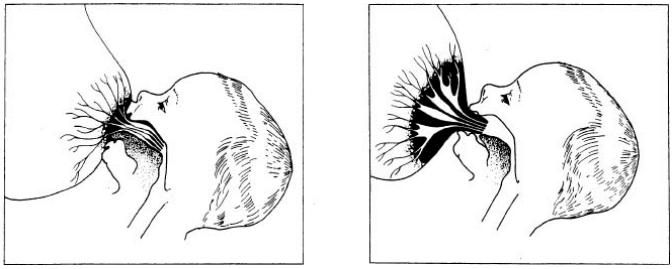


Figure 10.2: Good (left) and poor (right) attachment; cross-sectional view of the breast and baby



Figure 10.3 Good (left) and poor (right) positioning of infant for breastfeeding

Overcoming difficulties

'Not enough milk':

- Almost all mothers can produce enough breast milk for one or even two babies. However, sometimes the baby is not getting enough breast milk. The signs are:
- Poor weight gain (<500 g a month, or <125 g a week, or less than the birth weight after 2 weeks)
- Passing a small amount of concentrated urine (less frequent, yellow and strong-smelling).

Common reasons why a baby may not be getting enough breast milk are:

- Poor breastfeeding practices: poor attachment (very common cause), delayed start of breastfeeding, feeding at fixed times, no night feeds, short feeds, use of bottles, pacifiers, other foods and other fluids.
- Psychological factors in the mother: lack of confidence, worry, stress, depression, dislike of breastfeeding, rejection of baby, tiredness.
- Mother's physical condition: chronic illness (e.g. tuberculosis, severe anaemia or rheumatic heart disease), contraceptive pill, diuretics, pregnancy, severe malnutrition, alcohol, smoking, retained piece of placenta (rare).
- Baby's condition: illness, or congenital anomaly (such as cleft palate or congenital heart disease) which interferes with feeding.
- A mother whose breast milk supply is reduced will need to increase it, while a mother who has stopped breastfeeding may need to relactate if HIV negative.

Help a mother to breastfeed again by:

- Keeping the baby close to her and not giving him/her to other carers
- Having plenty of skin-to-skin contact at all times
- Offering the baby her breast whenever the baby is willing to suckle
- Helping the baby to take the breast by expressing breast milk into the baby's mouth, and positioning the baby so that the baby can easily attach to the breast
- Avoiding use of bottles, teats and pacifiers. If necessary, express the breast milk and give it by cup. If this cannot be done, artificial feeds may be needed until an adequate milk supply is established

How to increase the milk supply:

- The main way to increase or restart the supply of breast milk is for the baby to suckle often in order to stimulate the breast.
- Give other feeds from a cup while waiting for breast milk to come.
- Do not use bottles or pacifiers.
- Reduce the other milk by 30–60 ml per day as her breast milk starts to increase.
- Monitor the baby's weight gain.

Refusal or reluctance to breastfeed:

- The main reasons why a baby might refuse to breastfeed are:
- The baby is ill, in pain or sedated.
- If the baby is able to suckle, encourage the mother to breastfeed more often. If the baby is very ill, the mother may need to express breast milk and feed by cup or tube until the baby is able to breastfeed again.

- If the baby is in hospital, arrange for the mother to stay with the baby in order to breastfeed
- Help the mother to find a way to hold her baby without pressing on a painful place
- Explain to the mother how to clear a blocked nose. Suggest short feeds, more often than usual, for a few days.
- A sore mouth may be due to Candida infection (thrush) or teething. Treat the infection with nystatin (100 000 units/ml) suspension. Give 1–2 ml dropped into the mouth, 4 times a day for 7 days. If this is not available, apply 1% gentian violet solution. Encourage the mother of a teething baby to be patient and keep offering the baby the breast.
- If the mother is on regular sedation, reduce the dose or try a less sedating alternative

If there is difficulty with the breastfeeding technique:

- Help the mother with her technique: ensure that the baby is positioned and attached well without pressing on the baby's head, or shaking the breast.
- Advise her not to use a feeding bottle or pacifier; if necessary, use a cup
- Treat engorgement by removing milk from the breast; otherwise mastitis or an abscess may develop.
- If the baby is not able to suckle, help the mother to express her milk

- Help reduce oversupply. If a baby is poorly attached and suckles ineffectively, the baby may breastfeed more frequently or for a longer time, stimulating the breast so that more milk is produced than required. Oversupply may also occur if a mother tries to make her baby feed from both breasts at each feed, when this is not necessary. A change has upset the baby:

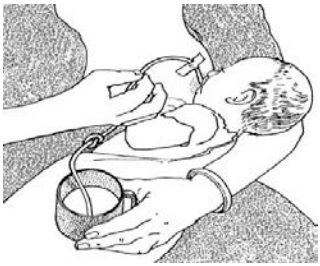


Figure Figure 10.4: Getting a baby to suckle using a breastfeeding supplementer (knot in tubing to control flow rate

Changes such as separation from the mother, a new carer, illness of the mother, or in the family routine or the mother's smell (due to a different soap, food or menstruation) can upset the baby and cause refusal to breastfeed.

- Low-birth-weight and sick infants
- Infants with a birth weight < 2.5 kg need breast milk even more than larger infants; often, however, they cannot breastfeed immediately after birth, especially if they are very small.
- For the first few days, an infant may not be able to take oral feeds and may have to be fed IV. Initiate early feeding with small oral

feeds even on day 1 or as soon as the infant can tolerate enteral feeds.

- Very low-birth-weight infants (< 1.5 kg) may have to be fed by naso- or oro-gastric tube during the first days of life. Preferably give the mother's expressed breast milk. The mother can let the infant suck on her cleaned finger while being tube fed. This may stimulate the infant's digestive tract and help weight gain.
- Low-birth-weight infants at ≥ 32 weeks' gestational age can start suckling on the breast. Let the mother put her infant to the breast as soon as the infant is well enough. Continue giving expressed breast milk by cup or tube to make sure that the infant gets all the nutrition needed.
- Infants at ≥ 34–36 weeks' gestational age can usually take all that they need directly from the breast.
- Babies who cannot breastfeed

Non-breastfed babies should receive either:

- Expressed breast milk (preferably from their own mothers)
- Formula milk prepared with clean water according to instructions or, if possible, ready-made liquid formula
- Replacement feeding using home modified animal milk is not recommended for infants less than 6 months of age.
- If the child is too weak to suck, feeding can be done with a cup.
- Feed by nasogastric tube if the child is lethargic or severely anorexic.



Figure 10.5: Feeding infant with expressed breast milk using a cup

Nutritional management of sick children

- The principles for feeding sick infants and young children are:
- Continue breastfeeding
- Do not withhold food
- Give frequent small feeds, every 2–3 hours
- Coax, encourage, and be patient
- Feed by nasogastric tube if the child is severely anorexic
- Promote catch-up growth after the appetite returns.

The food provided should be:

- Palatable (to the child)
- Easily eaten (soft or liquid consistency)
- Easily digested
- Nutritious (rich in energy and nutrients).

The basic principle of nutritional management is to provide a diet with sufficient energy-producing foods and high-quality proteins. Foods with a high oil or fat content are recommended. Up to 30–40% of the total calories can be given as fat. In addition, feeding at frequent intervals is necessary to achieve high energy intakes. If there is concern about the nutritional content of the food, provide multivitamin and mineral supplements.

The child should be encouraged to eat relatively small amounts frequently. If young children are left to feed by themselves, or have to compete with siblings for food, they may not get enough to eat.

A blocked nose, with dry or thick mucus, may interfere with feeding. Put drops of salted water or saline into the nose with a moistened wick to help soften the mucus.

In a minority of children who are unable to eat for a number of days (e.g. due to impaired consciousness in meningitis or respiratory distress in severe pneumonia), it may be necessary to feed by nasogastric tube. The risk of aspiration can be reduced if small volumes are given frequently.

To supplement the child's nutritional management in the hospital, feeding should be increased during convalescence to make up for any lost weight. It is important that the mother or carer should offer food to the child more frequently than normal (at least one additional meal a day) after the child's appetite increases.

Catch-up meals

The recipes provide 100 kcal and 3 g protein/100 ml. The individual servings contain approximately 200 kcal and 6 g protein. A child should eat seven meals in 24 h.

Recipe 1 (porridge without milk)

Ingredient	To make 1 litre	For one serving
Cereal flour	100 g	20 g
Groundnut or oilseed paste	100 g	20 g
Sugar	50 g	10 g

Make a thick porridge and then stir in the paste and sugar. Make up to 1 litre.

Recipe 2 (porridge with milk, or rice pudding)

Ingredient	To make 1 litre	For one serving
Cereal flour	125 g	25 g
Milk (fresh or long-life whole milk)	600 ml	120 ml
Sugar	75 g	15 g
Oil or margarine	25 g	5 g

Make a thick porridge with milk and just a little water (or use 75 g whole milk powder instead of the 600 ml liquid milk), then add sugar and oil. Make up to 1 litre.

For rice pudding, replace cereal flour with the same amount of rice.

These recipes may have to be supplemented with vitamins and minerals.

Recipe 3 (rice-based meal)

Ingredient	To make 600 g	For one serving
Rice	75 g	25
Lentils (dhal)	50 g	20 g
Pumpkin	75 g	25 g
Green leaves	75 g	25 g
Oil or margarine	25 g	10 g
Water	800 ml	

Put rice, lentils, pumpkin, oil, spices and water in a pot and cook with a lid on. Just before the rice is cooked, add chopped leaves. Cook for a few more minutes.

Recipe 4 (rice-based meal with cooked family foods)

Ingredient	Amount for one serving
Cooked rice	90 g (four and a half big spoons)[a]
Cooked mashed beans, peas or lentils	30 g (one and a half big spoons)
Cooked mashed pumpkin	30 g (one and a half big spoons)
Margarine or oil	10 g (two teaspoons)[b]

Soften the mashed foods with the oil or margarine

Recipe 5 (maize-based meal with family foods)

Ingredient	Amount for one serving
Thick maize porridge (cooked)	140 g (six big spoons)[a]
Groundnut paste	15 g (three teaspoons)[b]
Egg	30 g (one egg)
Green leaves	20 g (handful)

Stir groundnut paste and raw egg into cooked porridge. Cook for a few minutes. Fry onion and tomato for flavour and add leaves. Stir into porridge or serve separately.

[a] Big = 10 ml spoon, rounded
[b] Teaspoon = 5 ml

Feeding recommendations during sickness and health

Table 10.1: Feeding recommendation during sickness and health in Ethiopia - For infants up to 6 months of age

Birth up to 6 months



Breastfeed as often as the child wants, day and night, at least 8 times in 24 hours.
Feed your child only breast milk for the first 6 months, not even giving water.
Empty one breast before switching to the other for your baby to get the most nutritious hind milk.
During illness and for at least up to 2 weeks after the illness, increase the frequency of breastfeeding to recover faster.
Expose child to sunshine for 20 to 30 minutes daily.

Table 10.2.Feeding recommendation during sickness and health in Ethiopia - For infants 6-24 months of age

6-24 months



- Breastfeed as often as the child wants.
- Start complementary foods at 6 months.
- Give adequate servings of freshly prepared and enriched foods; porridge made of cereal and legume mixes, shirofitfiit, merekfitfit, mashed potatoes and carrot, mashed gommen, eggs and fruits.



- Enrich the food by adding some oil or butter every time; give also animal foods (meat, liver, fish, eggs), legumes, vegetables (green leafy, carrots) and yellow fruits (orange, papaya, mangos).
- Give these foods 3 times per day if breastfed, 5 times per day if not

breastfed (3 main meals and 2 snacks).

- Babies who stopped breastfeeding at 6 months should also get adequate milk replacement besides complementary feeding.
- Increase intake of food and fluids during illness, and give one additional meal of solid food for about 2 weeks after illness for fast recovery.
- Give Vitamin A supplements from the age of 6 months, 2 times per year.
- Expose child to sunshine.



- By 6 months of age, all children should be receiving a soft, nutritious complementary food.
- It is important to actively feed the child. Active feeding means encouraging the child to eat. The child should not have to compete with older brothers and sisters for food from a common plate. He should have his own serving. Until the child can feed himself, the mother or another caretaker (such as an older sibling, father, or grandmother) should sit with the child during meals and help get the spoon into his mouth.
- An "adequate serving" means that the child does not want any more food after active feeding.
- A good daily diet should be adequate in quantity and include an energy-rich food (for example, soft cereal based porridge with added oil); meat, fish, eggs, or pulses; and fruits and vegetables.

Table 10.3 Feeding recommendation during sickness and health in Ethiopia- 2 years and above

Two years and above



- Breastfeed as often as the child wants.
- Give adequate servings of enriched family foods: and porridge made of cereal and legume mixes, shiro, kik, merekfitfit, mashed potatoes and carrot, gommen, undiluted milk and egg and fruits.
- Add some extra butter or oil to child's food. Give also animal foods (meat, liver, fish, eggs), legumes, vegetables (green leafy, carrots) and yellow fruits (orange, papaya, mangos)
- Give these foods at least 5 times per day (3 meals and 2 snacks/mekses).
- Babies who stopped breast feeding at early age should also get adequate milk replacement besides complementary feeding.
- Give your baby his/her own servings and actively feed the child
- Give freshly prepared food and use clean utensils
- Increase intake of food and fluids during illness, and give one additional meal of solid food for about 2 weeks after illness for fast recovery
- Give Vitamin A supplements and Mebendazole every 6 months



- During this period the mother should continue to breastfeed as often as the child wants and also give nutritious complementary foods. The variety and quantity of food should be increased. Family foods should become an important part of the child's diet. Family foods should be appropriately prepared, so that they are easy for the child to eat.
- Give nutritious complementary foods or family foods 5 times a day.
- Adequate servings and active feeding (encouraging the child to eat) continue to be important.
- Give adequate servings of freshly prepared enriched family foods, 3-4 meals a day.
- Also, twice daily, give nutritious food between meals, such as: Egg, milk, fruits, kitta, dabo, ripe yellow fruits.
- Give your baby his/her own servings and actively feed the child.
- Give freshly prepared food and use clean utensils.
- Increase intake of food and fluids during illness, and give one additional meal of solid food for about 2 weeks after illness for fast recovery.
- Give Vitamin A supplements and Mebendazole every 6 months.



At this age the child should be taking a variety of family foods in 3 meals per day. The child should also be given 2 extra feedings between meals (snacks) per day. These may be family foods or other nutritious foods which are convenient to give between meals. Examples are listed on the COUNSEL chart and below.



10.3 Fluid management

The total daily fluid requirement of a child is calculated with the following formula: 100 ml/kg for the first 10 kg, then 50 ml/kg for the next 10 kg, thereafter 25 ml/kg for each subsequent kg. For example, an 8 kg baby receives 8 x 100 ml = 800 ml per day, a 15 kg child (10 x 100) + (5 x 50) = 1250 ml per day.

Table 10.5 Maintenance fluid requirements

Body weight of child	Fluid (ml/day)
2 kg	200 ml/day
4 kg	400 ml/day
6 kg	600 ml/day
8 kg	800 ml/day
10 kg	1000 ml/day
12 kg	1100 ml/day
14 kg	1200 ml/day
16 kg	1300 ml/day
18 kg	1400 ml/day
20 kg	1500 ml/day
22 kg	1550 ml/day
24 kg	1600 ml/day
26 kg	1650 ml/day

Give the sick child more than the above amounts if there is fever (increase by 10% for every 1°C of fever).

Monitoring fluid intake

Pay careful attention to maintaining adequate hydration in very sick children, who may have had no oral fluid intake for some time. Fluids should preferably be given orally (by mouth or nasogastric tube).

If fluids need to be given intravenously, it is important to monitor closely any infusion of I.V fluid given to a sick child because of the risk of fluid overload leading to heart failure or cerebral oedema. If it is impossible to monitor the I.V fluid infusion closely, then the I.V route should be used only for the management of severe dehydration, septic shock, the delivery of I.V antibiotics, and in children in whom oral fluids are contraindicated (such as in perforation of the intestine or other surgical abdominal problems).

IV maintenance fluids should preferably be isotonic fluids with 5% dextrose. Possible fluids include isotonic saline and Ringer's lactate. Do not give 5% glucose alone for extended periods as this can lead to hyponatraemia.

Example: to prepare 700 ml of normal saline in 10% dextrose, we need to add 70 grams of glucose. If the source of glucose is 40 % dextrose, we need 175 ml of 40% dextrose in water. Because of the 175 ml of 40% glucose, the total fluid becomes 875 ml 10% dextrose in normal saline.

10.4 Management of fever

Temperatures referred to in these guidelines are rectal temperatures, unless otherwise stated. Oral and axillary temperatures are lower by approximately 0.5°C and 0.8°C respectively.

Fever is not an indication for antibiotic treatment, and may help the immune defenses against infection. However, high fever (>39°C or >102.2°F) can have harmful effects such as:

- Reducing the appetite
- Making the child irritable

- Precipitating convulsions in some children aged between 6 months and 5 years
- Increasing oxygen consumption (e.g. in a child with very severe pneumonia, heart failure or meningitis)
- All children with fever should be examined for signs and symptoms which indicate the underlying cause of the fever, and should be treated accordingly.

Antipyretic treatment

Paracetamol

Treatment with oral paracetamol should be restricted to children aged ≥ 2 months who have a fever of ≥ 39°C (≥ 102.2°F), and are uncomfortable or distressed because of the high fever. Children who are alert and active are unlikely to benefit from paracetamol treatment. The dose of paracetamol is 15 mg/kg 6-hourly.

Ibuprofen

The effectiveness in lowering temperature and the safety of ibuprofen and acetaminophen are comparable, except that ibuprofen, like any NSAID, can cause gastritis and is slightly more expensive.

Ibuprofen dose is 10 mg/kg every 6–8 h.

Other agents

Aspirin is not recommended as a first-line antipyretic because it has been linked with Reye's syndrome, a rare but serious condition affecting the liver and brain. Avoid giving aspirin to children with acute viral infections such as chicken pox.

Other agents are not recommended because of their toxicity and inefficacy (dipyrone, phenylbutazone).

Supportive care

Children with fever should be lightly clothed, kept in a warm but well-ventilated room, and encouraged to increase their oral fluid intake. Sponging with tepid water lowers the temperature during the period of sponging only.

10.5 Pain control

Why do we treat pain?

The unchecked release of stress hormones by untreated pain may exacerbate injury, prevent wound healing, lead to infection, prolong hospitalization, and even lead to death.

Pain may also persist not only secondary to ongoing injury but rather from persistent or abnormal excitability in the peripheral or central nervous system in the absence of ongoing tissue injury; this form of pain is known as neuropathic.

Assessment of pain in children

Good assessment of pain contributes to the prevention and/or early recognistion of pain as well as its effective management. Proper pain assessment requires proper communication skills between the patient/and or the care taker (the family). There are many pain assessment tools but their application depends on the age of the child, level of consciousness and cognitive development.

The three fundamental methods for pain assessment tools are:

Physiological: primarily measuring physiological arousal consequent to pain. This includes increase in heart rate, blood pressure, respiratory rate, autonomic symptoms like vomiting, sweating, etc. These are non-specific and can be signs of other common childhood illnesses and therefore not usually used for pain management.

Behavioral-observation: measuring behavioral distress associated with pain. It mostly emphasizes on facial expression, crying and body movements. Facial expression measurements are most useful and specific.

We can use FLACC pain scale for children up to 3 years. FLACC scoring system may be used in children **0-3 years of age** and in mechanically ventilated or cognitively impaired children. It is an acronym that includes five indicators, each scored as a 0, 1, or 2 that forms a ten point composite scale with a range from “0” (no pain) to “10” (worst pain).

Table 10.6 behavioral Observation Pain Rating Scale (FLACC scale)

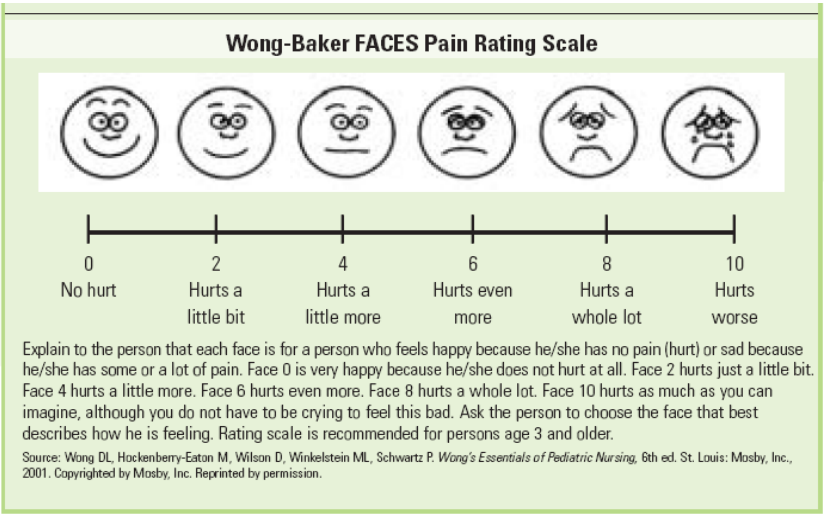
Score**:**	**0**	**1**	**2**
Face	No particular expression or smile; disinterested	Occasional grimace or frown, withdrawn	Frequent to constant frown clenched jaw; quivering chin
Legs	Normal, relaxed	Restless or tense	Kicking, legs withdrawn
Activity	Quiet, moves easily, normal position	Shifting or tense, moving back and forth	Rigid, arched, jerking
Cry	None (awake or asleep)	Moan, whimper	Steady crying, screaming, sobbing, or frequent complaints
Consolability	Content, relaxed	Consolable (reassured by occational touching or hagging	Inconsolable

Self reporting of pain (measuring expressed experience of pain): mostly children who are less than 3 years old cannot express their pain. Whenever feasible, it is preferred to try to get the level of pain from the patient and trust patients pain, as pain is a subjective experience. It is the best and golden standard approach.

For children between 3-8 years

They can quantify their pain and are able to translate it to visual representation. Therefore we use the visual analog scale which quantifies pain based up on a series of faces in different phases of happiness and crying. Wong Baker FACES Pain Rating Scale allows ranking the level of pain by observing the child's face

Figure 10.5 Pediatric faces scale for rating the intensity of pain



Explain to the person that each face is for a person who feels happy because he/she has no pain (hurt) or sad because he/she has some or a lot of pain. Face 0 is very happy because he/she does not hurt at all. Face 2 hurts just a little bit. Face 4 hurts a little more. Face 6 hurts even more. Face 8 hurts a whole lot. Face 10 hurts as much as you can imagine, although you do not have to be crying to feel this bad. Ask the person to choose the face that best describes how he is feeling. Rating scale is recommended for persons age 3 and older.

Source: Wong DL, Hockenberry-Eaton M, Wilson D, Winkelstein ML, Schwartz P. *Wong's Essentials of Pediatric Nursing*, 6th ed. St. Louis: Mosby, Inc., 2001. Copyrighted by Mosby, Inc. Reprinted by permission.

For children 8 years and above

Usually have a word for pain and can articulate more detail about the presence and location of pain. Therefore verbal rating scale can be used:

this is categorical scale for rating pain based on the patient's description. The response ranges from no pain to mild and moderate to severe pain.

Management of pain

Non-pharmacological treatment of pain:

- Distraction: is used to direct the child's attention away from the pain- various distractive techniques might be used like songs, play therapies, movies, bubbles, games etc
- Hot or cold therapy: hot or cold application at the source of pain might be helpful
- Massage therapy: massaging or rubbing is helpful. It enhances a sense of wellbeing and comfort
- Physical therapy: like exercise, rest, breathing exercise
- Diet: feeding the child with fruits, vegetables etc which are liked by the child
- Prayer
- Social support: encouragement, keeping the child near peer groups, story telling, reading books
- Bright or dim light

Use of anti-pains

Analgesics can be divided into three classes:

- Non-opioid (antipyretics)
- Opioid
- Adjuvants

Non-opioid and opioid analgesics both act peripherally and centrally. The principles governing analgesic use include:

- By the mouth: the oral route is the standard route for analgesics, including morphine and other strong opioids.
- By the clock: persistent pain requires preventive therapy. Analgesics should be given regularly and prophylactically; as needed (p.r.n.) medication alone is irrational and inhumane.
- By the ladder: use the analgesic ladder. If after optimizing the dose a drug fails to relieve, move up the ladder, do not move sideways in the same efficacy group.

Individualized treatment: the right dose is the one which relieves pain; doses should be titrated upwards until the pain is relieved or undesirable effects prevent further escalation.

Use of adjuvant drugs: in the context of analgesic ladder these include: other drugs which relieve pain in specific situations, drugs to control the undesirable effects of analgesics, concurrently prescribed psychotropic medications e.g. anxiolytics.

Non- opioid (antipyretic) analgesics

The non-opioid (antipyretic) analgesics include:

- Paracetamol
- Non-steroidal anti-inflammatory drugs (NSAIDS)

Paracetamol

Inhibits cyclo-oxygenase in the CNS. Though it has a peripheral analgesic effect, it doesn't have an anti-inflammatory effect in inflamed joints.
Paracetamol is different from NSAIDS in that:

- Side effects are uncommon
- Doesn't injure the gastric mucosa
- Well tolerated by patients with peptic ulcer
- Doesn't affect plasma uric acid concentration

- Has no effect on platelet function

NSAIDS can be used with paracetamol for additive effect. It has a potential hepatotoxicity.

NSAIDS

Have particular benefit for pains associated with inflammation. Drugs in this group include: Ibuprofen, diclofenac and naproxen. These drugs inhibit cyclo oxygenase, an important enzyme in the Arachidonic acid cascade which results in the production of tissue and inflammatory prostaglandins. **Aspirin,** because of its side effects like irreversible platelet dysfunction, is not recommended.

Adjuvants

Drugs in this group include:

- Corticosteroids
- Antidepressants, anti-epileptics
- NMDA-receptor-channel blockers
- Antispasmodics, muscle relaxants
- Biphosphonates

OPIOID analgesics

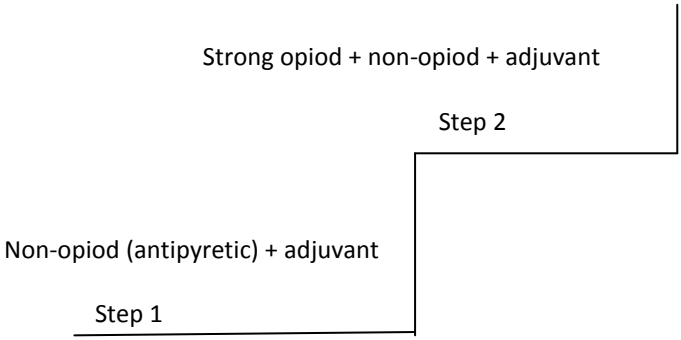
Weak opioids

Tramadol: Tramadol is another analgesic with opioid effects that has been considered for the control of moderate pain. However, there is currently no available evidence for its comparative effectiveness and safety in children. Furthermore, tramadol is not licensed for paediatric use in several countries. More research on tramadol and other intermediate potency opioids is needed.

Strong opioids: pain is a physiological antagonist to the central depressant effects of opioids. Strong opioids do not cause clinically important respiratory depression in patients in pain.

Morphine is metabolized mainly to morphine-3-glucoronide (M3G) and morphine-6-glucoronide (M6G). M3G is inactive but M6G is more potent than morphine. Both glucoronides accumulate in renal failure so the dose needs to be adjusted.

The recommended analgesic ladder for pain management



Non-pharmacologic and pharmacologic treatments have to be combined for an effective pain management.

Pharmacologic treatment of pain using a two-step strategy

Recommendation

It is recommended to use the analgesic treatment in two steps according to the child's level of pain severity.

The first step: mild pain

Paracetamol and ibuprofen are the medicines of choice in the first step (mild pain).

Table 10.7 Non-opioid analgesics for the relief of mild pain in neonates, infants and children

Medicine	Dose (oral route)			Maximum daily dose
	Neonates from 0 to 29 days	Infants from 30 days to 3 months	Infants from 3 to 12 months or child from 1 to 12 years	
Paracetamol	5–10 mg/kg every 6–8 hrs[a]	10 mg/kg every 4–6 hrs[a]	10–15 mg/kg every 4–6 hrs[a,b]	Neonates, infants and children: 4 doses/day
Ibuprofen			5–10 mg/kg every 6–8 hrs	Child: 40 mg/kg/day

[a] Children who are malnourished or in a poor nutritional state are more likely to be susceptible to toxicity at standard dose regimens due to reduced natural detoxifying glutathione enzyme.

[b] Maximum of 1 gram at a time.

The second step: moderate to severe pain

Morphine is the medicine of choice for the second step, although other strong opioids should be considered and made available to ensure an alternative to morphine in case of intolerable side-effects.

Opioid analgesics

To obtain a dose that provides adequate relief of pain with an acceptable degree of side-effects the doses of morphine or other strong opioids need to be gradually increased until effective. Unlike paracetamol and NSAIDs, there is no upper dosage limit for opioid analgesics because there is no "ceiling" analgesic effect. The appropriate dose is the dose that produces pain relief for the individual child. The goal of titration to pain relief is to select a dose that prevents the child from experiencing pain between two doses using the lowest effective dose. This is best achieved by frequent assessment of the child's pain relief response and adjusting the analgesic doses as necessary.

The opioid dose that effectively relieves pain varies widely between children, and in the same child at different times, and should, therefore, be based on the child's pain severity assessment. Large opioid doses given at frequent intervals may be necessary to control pain in some children; these doses may be regarded as appropriate, provided that the side-effects are minimal or can be managed with other medicines. An alternative opioid should be tried if patients experience unacceptable side-effects such as nausea, vomiting, sedation and confusion.

The use of strong opioid analgesics is recommended for the relief of moderate to severe persisting pain in children with medical illnesses.

Choice of strong opioids

Morphine is recommended as the first-line strong opioid for the treatment of persisting moderate to severe pain in children with medical illnesses.

There is insufficient evidence to recommend any alternative opioid in preference to morphine as the opioid of first choice.

Selection of alternative opioid analgesics to morphine should be guided by considerations of safety, availability, cost and suitability including patient-related factors.

The strong opioid that we have in Ethiopia is Ethio-morph. It is immediate release morphine syrup manufactured by EPHARM with different concentrations (5mg/5ml, 20 mg/5ml, and 50 mg/5ml in 120 ml.

The actual dose for each individual child is the dose that controls pain.

The oral initial dose would be:

- Infants less than 6 months of age 0.02 mg/kg q4h PO.
- Infants/children more than 6 months old 0.15-0.3 mg/kg/dose every 4 hours

- The child might require higher doses. The dose could be escalated by 33-50% depending on the response. If there is breakthrough pain in between the regular doses, the dose should be 5-15% of the total 24 hours dose or 50% of the 4 hours dose.
- If there are only 1-3 rescue doses no need of adjustment.
- If there are 4-5 rescue doses, assess and increase the scheduled dose

Side effects of morphine and their intervention

- Gastric stasis: metoclopramide 10-20 mg q4h
- Sedation: reduce the dose or give methylphenidate 10 mg o.d-b.d
- Agitation, delirium: haloperidol 3-5 mg stat
- Multifocal twitching: diazepam or lorazepam
- Movement induced vomiting: promethazine
- Constipation: start with bisacodyl suppository or cascara tabs.

Use the following local anesthetics for effective pain control:

- **Local anaesthetics:** for painful lesions in the skin or mucosa or during painful procedures.
- **Lidocaine**: apply on gauze to painful mouth ulcers before feeds (apply with gloves, unless the family member or health worker is HIV-positive and does not need protection from infection); it acts in 2–5 minutes.
- **Tetracaine**: apply to a gauze pad and place over open wounds; it is particularly useful when suturing

10.6 Management of anaemia

Anaemia (non-severe)

Young children (aged <6 years) are anaemic if their haemoglobin is 9.3 g/dl (approximately equivalent to a haematocrit of <27%). If anaemia is present, begin treatment except if the child is severely malnourished.

Investigation

- CBC, peripheral morphology
- RBC indices if possible
- Stool exam for ova of parasite

If the cause of anemia is iron defficiency

- Give (home) treatment with iron (daily dose of iron/folate tablet or iron syrup) for 14 days.

- Ask the parent to return with the child after 14 days. Treatment should be given for 3 months, where possible. It takes 2–4 weeks to correct the anaemia and 1–3 months after the haemoglobin reverts to normal to build up iron stores.

If the child is ≥ 2 years and has not had mebendazole in the previous 6 months, give one dose of mebendazole (500 mg) for possible hookworm or whipworm). Advise the mother about good feeding practices.

Blood transfusion

10.6.1 Storage of blood

Use blood that has been screened and found negative for transfusion-transmissible infections. Do not use blood that has passed its expiry date or has been out of the refrigerator for more than 2 hours.

Large volume rapid transfusion at a rate >15 ml/kg/hour of blood stored at 4 ° C may cause hypothermia, especially in small babies.

10.6.2 Problems in blood transfusion

Blood can be the vehicle for transmitting infections (e.g. malaria, syphilis, hepatitis B and C, HIV). Therefore, screen donors for as many of these infections as possible. To minimize the risk, only give blood transfusions when essential.

10.6.3 Indications for blood transfusion

There are five general indications for blood transfusion:

- Severe anaemia:
- All children with a haematocrit of ≤ 12% or Hb of ≤ 4 g/dl
- Acute blood loss, when 20–30% of the total blood volume has been lost and bleeding is continuing
- Less severely anaemic children (haematocrit 13–18%; Hb 4–6 g/dl) with any of the following clinical features
- Septic shock (if IV fluids are insufficient to maintain adequate circulation and in addition to antibiotic therapy)
- To provide plasma and platelets for clotting factors, if specific blood components are not available
- Exchange transfusion in neonates with severe jaundice.

10.6.4 Giving a blood transfusion

Before transfusion, check the following:

- The blood is the correct group and the patient's name and number are on both the label and the form (in an emergency, reduce the risk of incompatibility or transfusion reactions by cross-matching group-specific blood or giving O-negative blood if available)
- The blood transfusion bag has no leaks

- The blood pack has not been out of the refrigerator for more than 2 hours, the plasma is not pink or has large clots, and the red cells do not look purple or black
- No sign of heart failure. If present, give 1mg/kg of furosemide IV at the start of the transfusion in children whose circulating blood volume is normal. Do not inject into the blood pack.
- In severely malnourished children, fluid overload is a common and serious complication. Give packed cells where available or whole blood, 10 ml/kg body weight (rather than 20 ml/kg), once only and do not repeat the transfusion
- Do a baseline recording of the child's temperature, respiratory rate and pulse rate. The volume transfused should initially be 20 ml/kg body weight of whole blood, given over 3–4 hours.

During transfusion:

- If available, use an infusion device to control the rate of the transfusion
- Check that the blood is flowing at the correct speed
- Look for signs of a transfusion reaction (see below), particularly carefully in the first 15 minutes of the transfusion
- Record the child's general appearance, temperature, pulse and respiratory rate every 30 minutes
- Record the time the transfusion was started and ended, the volume of blood transfused, and the presence of any reactions.

After transfusion:

Reassess the child. If more blood is needed, a similar quantity should be transfused and the dose of furosemide (if given) repeated.



Giving a blood transfusion: Note: A burette can be used to measure the blood volume, and the arm is splinted to prevent flexion of the elbow.

10.6.5 Transfusion reactions

If a transfusion reaction occurs, first check the blood pack labels and patient's identity. If there is any discrepancy, stop the transfusion immediately and notify the blood bank.

Mild reactions (due to mild hypersensitivity)

Signs and symptoms:

Itchy rash

Management:

- Slow the transfusion
- Give chlorphenamine 0.1 mg/kg IM, if available

- Continue the transfusion at the normal rate if there is no progression of symptoms after 30 minutes
- If symptoms persist, treat as moderate reaction (see below).
- **Moderately severe reactions** (due to moderate hypersensitivity, non-haemolytic reactions, pyrogens or bacterial contamination)

Signs and symptoms:

- Severe itchy rash (urticaria)
- Flushing
- Fever >38 ° C (Note: fever may have been present before the transfusion)
- Rigors
- Restlessness
- Raised heart rate.

Management:

Stop the transfusion, but keep the IV line open with normal saline

- Give IV 200 mg hydrocortisone, or chlorphenamine 0.25 mg/kg IM, if available
- Give a bronchodilator, if wheezing (see chapter 1).
- Send the following to the Blood Bank: the blood-giving set that was used, blood sample from another site, and urine samples collected over 24 hours.
- If there is improvement, restart the transfusion slowly with new blood and observe carefully
- If no improvement in 15 minutes, treat as life-threatening reaction (see below), and report to doctor in charge and to the Blood Bank.

- Life-threatening reactions (due to haemolysis, bacterial contamination and septic shock, fluid overload or anaphylaxis)

Signs and symptoms:

- Fever >38°C (note: fever may have been present before the transfusion)
- Rigors
- Restlessness
- Raised heart rate
- Fast breathing
- Black or dark red urine (haemoglobinuria)
- Unexplained bleeding
- Confusion
- Collapse
- Note that in an unconscious child, uncontrolled bleeding or shock may be the only signs of a life-threatening reaction.

Management:

- Stop the transfusion, but keep the IV line open with normal saline
- Maintain airway and give oxygen (see chapter 1). Give epinephrine (adrenaline) 0.01 mg/kg body weight (equal to 0.1 ml of 1 in 10 000 solution
- Treat shock (see chapter 1)
- Give IV 200 mg hydrocortisone, or chlorpheniramine 0.1 mg/kg IM, if available
- Give a bronchodilator, if wheezing

- Report to doctor in charge and to blood laboratory as soon as possible
- Maintain renal blood flow with IV furosemide 1 mg/kg
- Give antibiotic as for septicaemia

10.7 Oxygen therapy

Indications*:* Where available, oxygen therapy should be guided by pulse oximetry. Give oxygen to children with SaO_2<90%, and increase oxygen to achieve a SaO_2 >90%. Where pulse oximeters are not available, the need for oxygen therapy needs to be guided by clinical signs, which are less reliable. Where the oxygen supply is limited, priority should be given to children with very severe pneumonia, bronchiolitis, or asthma who:

- Have central cyanosis, or
- Are unable to drink (where this is due to respiratory distress).
- Where the oxygen supply is more plentiful, it should be given to children with any of the following:
- Severe lower chest wall indrawing
- Respiratory rate of 70/min or above
- Grunting with every breath (in young infants)
- Head nodding

Sources:

Oxygen supplies should be available at all times. The two main sources of oxygen are cylinders and oxygen concentrators. It is important that all equipment is checked for compatibility.

Oxygen cylinders and concentrators

See list of recommended equipment for use with oxygen cylinders and concentrators and instructions for their use in the WHO technical review paper, Oxygen therapy in the management of a child with an acute respiratory infection and the WHO manual Clinical use of oxygen.

Oxygen delivery

Three methods are recommended for the delivery of oxygen: nasal prongs, nasal catheter and nasopharyngeal catheter. Nasal prongs or a nasal catheter are preferred in most circumstances. Nasal prongs are the best method for delivering oxygen to young infants and children with severe croup or pertussis.

Use of a nasopharyngeal catheter calls for close monitoring and prompt action, in case the catheter enters the oesophagus or other serious complications develop. The use of face masks or head boxes is not recommended.

Nasal prongs: These are short tubes inserted into the nostrils. Place them just inside the nostrils and secure with a piece of tape on the cheeks near the nose (see figure). Care should be taken to keep the nostrils clear of mucus, which could block the flow of oxygen.

- Set a flow rate of 1–2 litres/min (0.5 litre/min in young infants) to deliver an inspired oxygen concentration of 30–35%. Humidification is not required with nasal prongs.



Figure 10.6: Oxygen therapy: Nasal prongs correctly positioned and secured.

Nasal catheter: This is a 6 or 8 FG catheter which is passed to the back of the nasal cavity. Place the catheter at a distance from the side of the nostril to the inner margin of the eyebrow.

- Set a flow rate of 1–2 litres/min. Humidification is not required with a nasal catheter.



40-45% o2 Oxygen therapy: correct position of nasal catheter (cross-sectional view)



Figure 10.8: A: Measuring the distance from nose to the tragus of the ear for the insertion of a nasopharyngeal catheter

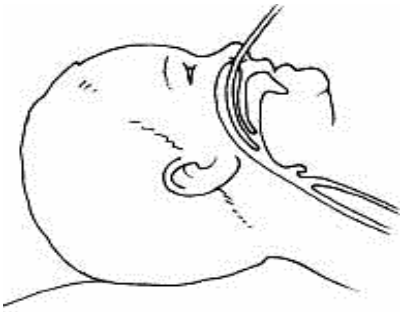


Figure 10.9: B. Cross sectional view of the position of the nasopharyngeal catheter

***Nasopharyngeal catheter*:** This is a 6 or 8 FG catheter which is passed to the pharynx just below the level of the uvula. Place the catheter at a distance equal to that from the side of the nostril to the front of the ear (see figure B, above). If it is placed too far down, gagging and vomiting and, rarely, gastric distension can occur.

- Set a flow rate of 1–2 litres/min, which delivers an inspired oxygen concentration of 45–60%. It is important that this flow rate is not exceeded because of the risk of gastric distension. Humidification is required.

Monitoring

Train the nurses to place and secure the nasal prongs or catheter correctly. Check regularly that the equipment is working properly, and remove and clean the prongs or catheter at least twice a day.

Monitor the child at least every 3 hours to identify and correct any problems, including:

- SaO_2 by pulse oximeter
- Nasal catheter or prongs out of position
- Leaks in the oxygen delivery system
- Oxygen flow rate not correct
- Airway obstructed by mucus (clear the nose with a moist wick or by gentle suction)
- Gastric distension (check the catheter's position and correct it, if necessary).

Pulse oximetry

A pulse oximeter is a machine which measures non-invasively the oxygen saturation in the blood. For this, it transmits a light beam through tissue

such as a finger, a toe, or in small children the whole hand or foot. The saturation is measured in the small arteries, and is therefore referred to as the arterial oxygen saturation (SaO2). There are reusable probes which last several months, and disposable ones.

Normal oxygen saturation at sea level in a child is 95–100%; with severe pneumonia, as oxygen uptake in the lung is impeded, it can drop. Oxygen is usually given with a saturation <90% (measured at room air). Different cut-offs might be used at altitude or if oxygen is scarce. The response to oxygen therapy can be measured with the pulse oximeter as well, as the SaO_2 should increase if the child has lung disease (with cyanotic heart disease, SaO_2 does not change when oxygen is given). The oxygen flow can be titrated with the pulse oximeter to obtain a stable SaO_2>90% without wasting too much oxygen.

Duration of oxygen therapy

Continue giving oxygen continuously until the child is able to maintain a SaO_2>90% in room air. When the child is stable and improving, take the child off oxygen for a few minutes. If the SaO_2 remains above 90%, discontinue oxygen, but check again 1/2 hour later, and 3 hourly thereafter on the first day off oxygen to ensure the child is stable. Where pulse oximetry is not available, the duration of oxygen therapy is guided by clinical signs, which are less reliable.

10.8 Toys and Play Therapy

Each play session should include language and motor activities, and activities with toys.

Language activities

Teach the child local songs. Encourage the child to laugh, vocalize and describe what he or she is doing.

Motor activities

Always encourage the child to perform the next appropriate motor activity.

Activities with toys

Ring on a string (from 6 months)

Thread cotton reels and other small objects (e.g. cut from the neck of plastic bottles) on to a string. Tie the string in a ring, leaving a long piece of string hanging.



Figure 10.10: Ring on a string (from 6 months)

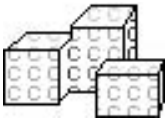


Figure 10.11: Blocks (from 9 months) Small blocks of wood: Smooth the surfaces with sandpaper and paint in bright colors, if possible.



Figure 10.12: Nesting toys (from 9 months).Cut off the bottom of two bottles of identical shape, but different size. The smaller bottle should be placed inside the larger

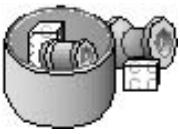


Figure 10.13 In-and-out toys (from 9 months). Any plastic or cardboard container and small objects (not small enough to be swallowed)



Figure 10.14: Rattle (from 12 months)Cut long strips of plastic from colored plastic bottles. Place them in a small transparent plastic bottle and glue the top on firmly.

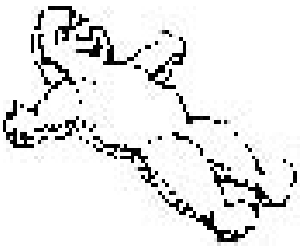
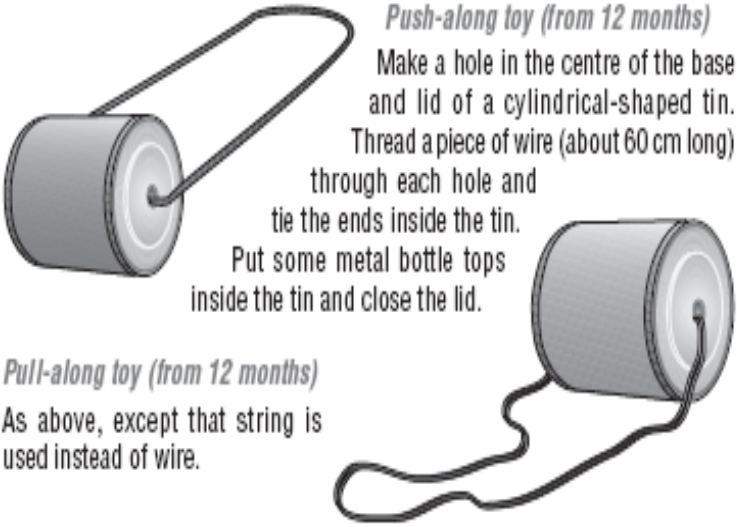


Figure 10.15 Doll (from 12 months)
Cut out two doll shapes from a piece of cloth and sew the edges together, leaving a small opening. Turn the doll inside-out and stuff with scraps of materials. Stitch up the opening and sew or draw a face on the doll.


Push-along toy (from 12 months)
Make a hole in the centre of the base and lid of a cylindrical-shaped tin. Thread a piece of wire (about 60 cm long) through each hole and tie the ends inside the tin. Put some metal bottle tops inside the tin and close the lid.
Pull-along toy (from 12 months)
As above, except that string is used instead of wire.



Stacking bottle tops (from 12 months)

Cut at least three identical round plastic bottles in half and stack them.

Mirror (from 18 months)

A tin lid with no sharp edges.



Puzzle (from 18 months)

Draw a figure (e.g. a doll) using a crayon on a square- or rectangular-shaped piece of cardboard. Cut the figure in half or quarters.



Book (from 18 months)

Cut out three rectangular-shaped pieces of the same size from a cardboard box. Glue or draw a picture on both sides of each piece. Make two holes down one side of each piece and thread string through to make a book.

CHAPTER 11 - MONITORING THE CHILD'S PROGRESS

Monitoring is a regular follow up of treatment out comes for patients under medical care. It starts from the time when patients present to the health facility seeking care.

11.1 Monitoring procedures

In order for monitoring to be effective, the health worker needs to know:

- the correct diagnosis of the illness
- the importance of shared confidentiality
- the correct management protocol and administration of the treatment
- the expected progress of the child
- the possible adverse effects of the treatment
- the complications that may arise and how these can be identified
- the possible alternative diagnoses in a child not responding to treatment
- the importance of parental involvement in the management of the child
- the importance of complete documentation of findings

Children treated in hospital should be checked regularly so that any deterioration in their condition, as well as complications, adverse effects of treatment, or errors in the administration of treatment can be identified promptly. The frequency of monitoring depends on the severity and nature of the illness.

Details of the child's condition and progress should be recorded so that the documents can be reviewed by other members of staff. A senior health

worker who is responsible for the care of the child, and has the authority to change treatment, should supervise these records and examine the child on a regular basis.

Children who are seriously ill should be visited if possible by a senior health professional soon after the child's admission to hospital. These visits should also be seen as an opportunity to encourage communication between the families of sick children and hospital staff.

11.2 Monitoring chart

A monitoring chart should include the following items.

1. Patient's details
2. Vital signs (Temperature, Respiratory Rate, Pulse Rate, Blood Pressure)
3. Anthropometry (Weight, Height, Head Circumference)
4. Relevant systemic findings
5. Level of consciousness, coma score (AVPU)
6. Fluid balance (input/output measurement)
7. Clinical diagnosis: presence of clinical signs and complications. At each review of the child, record whether these signs are still present. Record any new signs or complications and progressive assessment.
8. Treatments given
9. Investigation findings
10. Adverse events of treatment (if any).
11. Feeding/nutrition (type, amount, frequency, any feeding problems (see Chapter 7&10)
12. Outcome on discharge, advice and follow-up

11.3 Quality and audit of paediatric care

Quality of health service is defined as “the degree to which health services for individuals and populations increase the likelyhood of achieving desired health outcomes and are consistent with current professional knowledge”. It is becoming a public health concern in many countries including Ethiopia.

All stakeholders (government administrators, funding agencies, beneficiaries and providers) are raising quality as a policy and basic right issues.

Quality is determined by structural (administrative competencies, provision of necessary inputs, etc) and technical (staff competency, motivation, etc) factors. Ethiopia has started quality improvement as an essential element of health services while the country is undergoing a rapid and voluminous expansion of health services to improve the coverage and access. Quality of service must be the concern in every unit/department in health institutions including pediatrics units (OPD, in patient unit, etc).

The quality of care given to sick children in hospital can be improved if there is a system for reviewing the outcomes of each child admitted to the hospital. At a minimum, the system should keep records of all children who died in the hospital. Trends in case fatality rates over time can then be compared, and the treatment given can be discussed by all staff with the aim of identifying any problems and devising solutions. Clinical audit meetings to discuss near-death events or deaths in children, especially those in which some aspect of treatment might have gone wrong, can also be helpful. The aim is to improve care and solve problems, not to attribute blame for errors.

An audit of hospital paediatric care can be carried out by comparing the quality of care actually given with a recognized national standard, such as the recommendations contained in this pocket book. A successful audit calls for the full and constructive participation of all medical and nursing staff.

- The audit should be simple and not take up too much time, which is required for caring for the sick children.
- One suggestion is to ask medical and nursing staff for their views on improving the quality of care, and to give priority to these conditions or problems.
- Communication among hospital administration, pediatrics care team and client is of paramount importance to improve the quality of pediatrics care.
- There must be an understanding of the fact that proper documentation of child's medical information (clinical evaluation, treatment and progress) is part and parcel of a good quality pediatrics care.

CHAPTER 12 - COUNSELING AND DISCHARGE FROM HOSPITAL

The discharge process for all children should include:

- Correct timing of discharge from hospital
- Counseling the mother on treatment and feeding of the child at home
- Ensuring that the child's immunization status and record card are up-to-date
- Communicating with the health worker who referred the child or who will be responsible for follow-up care
- Giving instructions on when to return to the hospital for follow-up and on symptoms and signs indicating the need to return urgently. Written instruction for medication type , dose and duration of treatment
- Assisting the family with special support (e.g. providing equipment for a child with a disability, or linking with community support organizations for children with HIV/AIDS)

12.1 Timing of discharge from hospital

In general, in the management of acute infections, the child can be considered ready for discharge after the clinical condition has improved markedly (afebrile, alert, eating and sleeping normally) and oral treatment has been tolerated.

Decisions on when to discharge should be made on an individual basis, taking into consideration a number of factors, such as:

- The family's home circumstances and how much support is available to care for the child

- The staff's judgment of the likelihood that the treatment course will be completed at home
- The staff's judgment of the likelihood that the family will return immediately to the hospital if the child's condition should worsen

Timing of discharge of the child with severe malnutrition is particularly important and is discussed separately (See Chapter 7). In every case, the family should be given adequate and convincing information as to the discharge date so that appropriate arrangements can be made to support the child at home.

If the family wants to take the child prematurely against the advice of the hospital staff, every effort must be made to counsel the mother on how to continue treatment at home and encourage her to bring the child for follow-up after 1–2 days, and to make contact with the local health worker for help in the follow-up care of the child.

12.2 Counseling

Counseling of the caregivers is integral part of the comprehensive care delivered to any sick child. Counseling needs time, concern to parental feelings, empathy and recognizing the understanding level of parents. Counseling must be participatory and may be done repeatedly. Messages must be brief and easy to remember. Communication skill of health workers is of paramount importance in delivering a proper counseling. Older children can be involved in the counseling process. Tools for counseling will help facilitate communication and can build confidence for the caregivers. During counseling provide an effective interpreter if language is a barrier

Mother's Card

A simple, pictorial card reminding the mother of home care instructions, when to return for follow-up care, and the signs indicating the need to return immediately to the hospital can be given to each mother. Mother's

Card will help her to remember the appropriate foods and fluids, and when to return to the health worker.

Appropriate Mother's Cards are already developed as part of training for Integrated Management of Neonatal and Childhood Illness (IMNCI) in the country.

When reviewing the Mother's Card with the mother:

- Hold the card so that she can easily see the pictures, or allow her to hold it herself.
- Point to the pictures as you talk, and explain each one; this will help her to remember what the pictures represent.
- Mark the information that is relevant to the mother. For example, put a circle round the feeding advice for the child's age, and round the signs to return immediately. If the child has diarrhoea, tick the appropriate fluid(s) to be given. Record the date for the next immunization.
- Watch to see if the mother looks worried or puzzled. If so, encourage questions.
- Ask the mother to tell you in her own words what she should do at home. Encourage her to use the card to help her remember.
- Give her the card to take home. Suggest she show it to other family members. (If you do not have a large enough supply of cards to give to every mother, keep several in the clinic to show to mothers.)

12.3 Nutrition counseling

For HIV counseling, see chapter 8

Identifying feeding problems

First, identify any feeding problems which have not been fully resolved.

Ask the following questions:

- Do you breastfeed your child?
- How many times during the day?
- Do you also breastfeed during the night?
- Does the child take any other food or fluids?
- What food or fluids?
- How many times a day?
- What do you use to feed the child?
- How large are the servings?
- Does the child receive his/her own serving?
- Who feeds the child and how?

Compare the child's actual feeding with the recommended guidelines for feeding a child of that age (see chapter 10). Identify any differences and list these as feeding problems.

In addition, consider:

- Difficulty in breastfeeding
- Use of a feeding bottle
- Lack of active feeding
- Not feeding well during the illness

Advise the mother how to overcome problems and how to feed the child. Counsel the mother to give locally appropriate energy-rich and nutrient-rich complementary foods. Even when specific feeding problems are not found, praise the mother for what she does well. Give her advice that promotes:

Breastfeeding

Improved complementary feeding practices using locally available energy- and nutrient-rich foods

- Giving nutritious snacks to children aged ≥2 years.
- Examples of nutritionally adequate diets (see chapter 10)

12.4 Home treatment

- Use words the mother understands.
- Use teaching aids that are familiar (e.g. common containers for mixing ORS).
- Allow the mother to practice what she must do, e.g. preparing ORS solution or giving an oral medication, and encourage her to ask questions.
- Give advice in a helpful and constructive manner, praising the mother for correct answers or good practice.
- Teaching mothers is not just about giving instructions. It should include the following steps:
    - Give information: Explain to the mother how to give the treatment, e.g. preparing ORS, giving an oral antibiotic, or applying eye ointment.
    - Show an example: Show the mother how to give the treatment by demonstrating what to do.
    - Let her practice: Ask the mother to prepare the medicine or give the treatment while you watch her. Help her as needed, so that she does it correctly.

- Check her understanding: Ask the mother to repeat the instructions in her own words, or ask her questions to see that she has understood correctly.

12.5 Checking the mother's health

If the mother is sick, provide treatment for her and help to arrange follow-up at a first-level clinic close to her home. Check the mother's nutritional status and give any appropriate counseling. Check the mother's immunization status and, if needed, arrange so that she can get tetanus toxoid. Make sure the mother has access to family planning, birth spacing and counseling about preventing sexually-transmitted diseases and HIV. If the child has tuberculosis, the mother should also be investigated for TB including having chest X-ray.

12.6 Checking immunization status

Ask to see the child's immunization card, and determine whether all the immunizations recommended for the child's age have been given. Note any immunizations the child still needs and explain this to the mother; then carry them out before the child leaves hospital and record them on the card.

Recommended immunization schedule:

Table 12.1 National EPI vaccines and schedule

Age	Vaccine
Birth	BCG and OPV0
6 weeks	DPT1-HepB1-Hib1,rota , pneumococcal and OPV1
10 weeks	DPT2-HepB2-Hib2,rota, pneumococcal and OPV2
14 weeks	DPT3-HepB3-Hib3 pneumococcal and OPV3
9 months	Measles* and Vitamin A

**In exceptional situations give an extra dose of measles vaccine at 6 months of age for groups at high risk of measles death, such as infants in refugee camps, child with severe acute malnutrition and infants affected by disasters and during outbreaks of measles.*

Contraindications
It is important to immunize all children, including those who are sick and malnourished, unless there are contraindications. There are only 3 Contraindications to immunization:

Do not give BCG vaccines to a child with symptomatic HIV infection/AIDS, but do give the other vaccines.

- Give all immunizations, including BCG to a child with asymptomatic HIV infection.
- Do not give DPT-2 or -3 to a child who has had convulsions or shock within 3 days of the most recent dose.
- Do not give DPT to a child with recurrent convulsions or an active neurological disease of the central nervous system.

A child with diarrhoea who is due to receive OPV should be given a dose of OPV. However, this dose should not be counted in the schedule. Make a note on the child's immunization record that it coincided with diarrhoea, so that the health worker will know this and give the child an extra dose during the next visit.

12.7 Communicating with the first-level health worker
Information needed
The first-level health worker who referred the child to hospital should receive information about the child's care in hospital, which should include:

- Diagnosis/diagnoses
- Treatment(s) given (and duration of stay in hospital)

- Response of the child to this treatment
- Instructions given to the mother for follow-up treatment or other care at home
- Other matters for follow-up (e.g. immunizations).

These details should be recorded in a short note for the mother and health worker on the referral slip as a feedback. If there is further information that is important to be told to the health worker, telephone communication can be used if applicable.

12.8 Providing follow-up care

Children who do not require hospital admission but can be treated at home

Advise all mothers who are taking their children home, after assessment in the hospital, when to go to a health worker for follow-up care. Mothers may need to return to hospital:

- For a follow-up visit in a specific number of days (e.g. when it is necessary to check progress or the response to an antibiotic)
- If signs appear that suggest the illness is worsening
- For the child's next immunization.

It is especially important to teach the mother the signs indicating the need to return to hospital immediately. Guidance on the follow-up of specific clinical conditions is given in appropriate sections of this pocket book.

Follow-up for feeding and nutritional problems

- If a child has a feeding problem and you have recommended changes in feeding, follow up in 5 days to see if the mother has made the changes, and give further counseling if needed.
- If a child has anaemia, follow up in 14 days to give more oral iron

- Use also follow up schedule after management of severe acute malnutrition.

When to return immediately

Advise the mother to return immediately if the child develops any of the following signs:

- Not able to drink or breastfeed
- Becomes sicker
- Develops a fever
- Signs of illness return again after successful treatment in hospital
- In a child with a cough or cold: fast or difficult breathing
- In a child with diarrhoea: blood in stool or drinking poorly

Next well-child visit

Remind the mother about the child's next visit for immunization and record the date on the Mother's Card or the child's immunization record.

ANNEX 1

Practical procedures

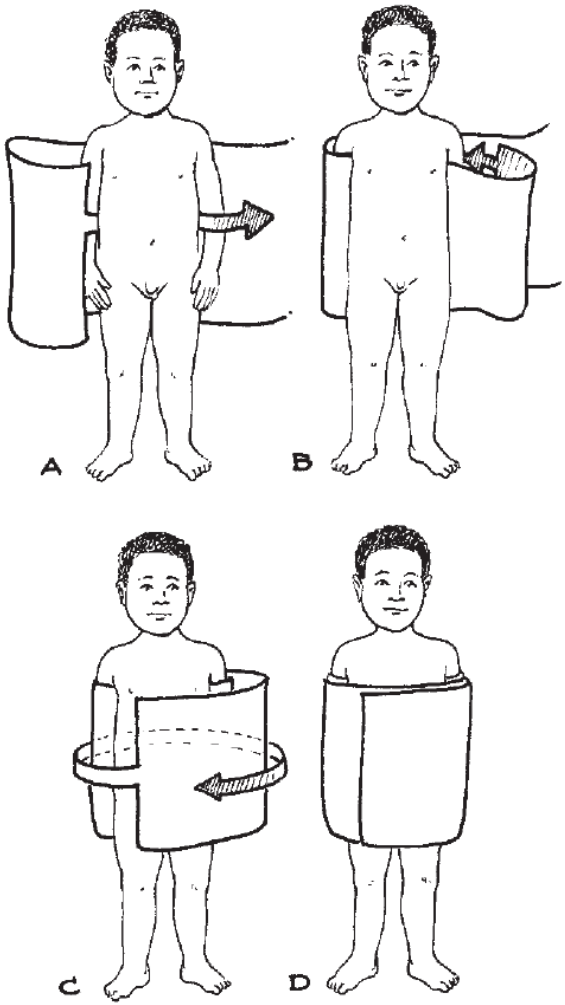
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Practical procedures should first be explained to the parents or to the child if she or he is old enough; any risks should also be discussed with them and their consent obtained. Procedures on young infants should be carried out in warm surroundings to avoid hypothermia. Good light is essential. Older children should be told what is to happen. Analgesia should be given when necessary.

Analgesia and sedation for procedures

For some procedures (e.g. chest tube insertion or femoral cannulation), sedation with diazepam or light anaesthesia with ketamine should be considered (see section 9.1.2, p. 258).

For diazepam sedation, give 0.1–0.2 mg/kg IV. For ketamine, give 2–4 mg/kg IM; this takes 5–10 min to act and lasts for about 20 min.



Wrapping the child to hold him or her securely during a practical procedure

One end of a folded sheet should be pulled through under the arms on both sides (A and B). The other end is then brought across the front and wrapped around the child (C and D).

Restraining the child for examination of eyes, ears or mouth



When giving any sedation or light anaesthesia, manage the child's airway, beware of respiratory depression, and monitor oxygen saturation with a pulse oximeter, when possible. **Make sure** you have a resuscitation bag available and, if possible, oxygen.

A1.1 Giving Injections

First, find out whether the child has reacted adversely to drugs in the past. Wash your hands thoroughly. Use disposable needles and syringes.

Clean the chosen site with an antiseptic solution. Carefully check the dose of the drug to be given, and draw the correct amount into the syringe. Expel the air from the syringe before injecting. Always record the name and amount of the drug given. Discard disposable syringes in a safe container.

A1.1.1 Intramuscular

In children aged > 2 years, give the injection into the outer thigh or the upper, outer quadrant of the buttock, well away from the sciatic nerve. In younger or severely malnourished children, use the outer side of the thigh midway between the hip and the knee or over the deltoid muscle in the upper arm. Push the needle (23–25-gauge) into the muscle at a 90° angle (45° angle in the thigh). Draw back the plunger to make sure there is no blood (if there is, withdraw slightly and try again). Give the drug by pushing the plunger slowly until the end. Remove the needle, and press a small swab or cotton-wool firmly over the injection site.



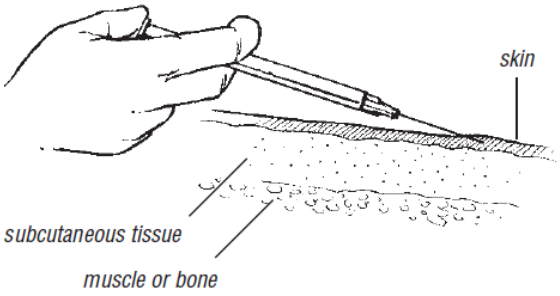
Intramuscular injection into the thigh

A1.1.2 Subcutaneous

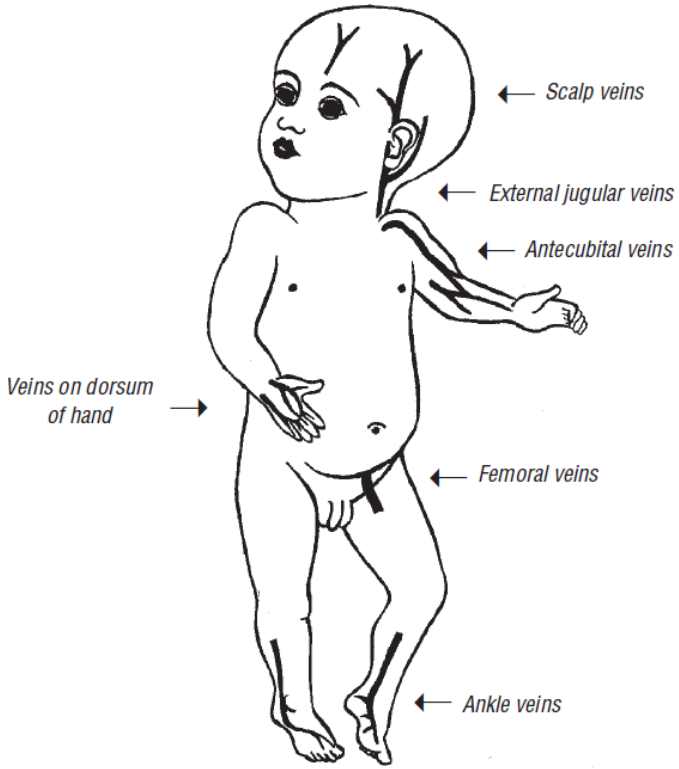
Select the site as described above for intramuscular injection. Push the needle (23–25-gauge) under the skin at a 45° angle into the subcutaneous fatty tissue. Do not enter the underlying muscle. Draw back the plunger to make sure there is no blood (if there is, withdraw slightly and try again). Give the drug by pushing the plunger slowly until the end. Remove the needle and press cotton-wool firmly over the injection site.

A1.1.3 Intradermal

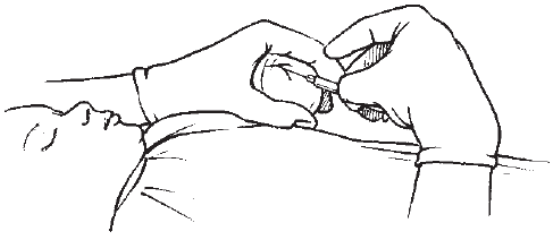
For an intradermal injection, select an undamaged, uninfected area of skin (e.g. over the deltoid in the upper arm). Stretch the skin between the thumb and forefinger of one hand; with the other, slowly insert the needle (25 gauge), bevel upwards, about 2 mm just under and almost parallel to the surface of the skin. Considerable resistance is felt when injecting intradermally. A raised, blanched bleb showing the surface of the hair follicles is a sign that the injection has been given correctly.



Intradermal injection (for example in Mantoux test)



Sites for IV access in infants and young children



Inserting an IV cannula into a vein on the back of the hand. The hand is bent to obstruct venous return and thus make the veins visible.

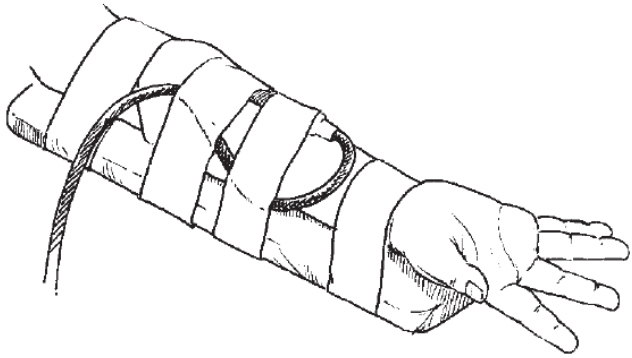
A1.2 Giving parenteral fluids

A1.2.1 Insertion of an indwelling intravenous cannula in a peripheral vein

Select a suitable vein to place the cannula or a gauge 21 or 23 butterfly needle.

Peripheral vein

- Identify an accessible peripheral vein. In young children aged > 2 months, this is usually the cephalic vein in the antecubital fossa or the fourth interdigital vein on the dorsum of the hand.
- An assistant should keep the position of the limb steady and should act as a tourniquet by obstructing the venous return with his or her fingers lightly closed around the limb.
- Clean the surrounding skin with an antiseptic solution (such as spirit, iodine, isopropyl alcohol or 70% alcohol solution), then introduce the cannula into



Splinted arm for IV infusion to prevent bending of the elbow

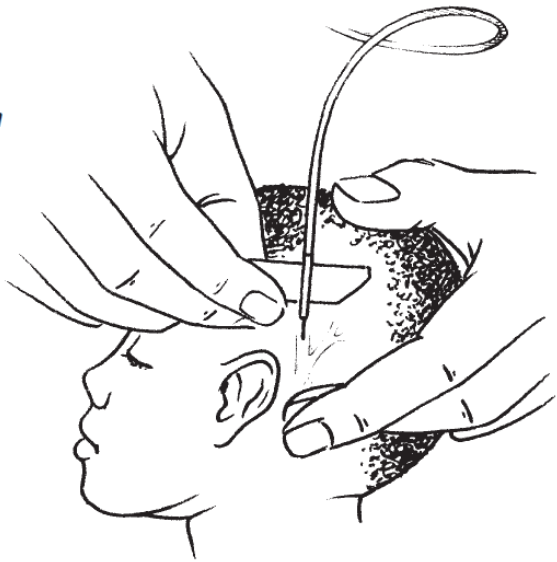
the vein and insert most of its length. Fix the catheter securely with tape. Apply a splint with the limb in an appropriate position (e.g. elbow extended, wrist slightly flexed).

Scalp vein

These are often used in children aged < 2 years but are most suitable in young infants.

- Find a suitable scalp vein (usually in the midline of the forehead, the temporal area, or above or behind the ear).
- Shave the area if necessary, and clean the skin with an antiseptic solution. The assistant should occlude the vein proximal to the site of puncture. Fill a syringe with normal saline, and flush the butterfly set. Disconnect the syringe and leave the end of the tubing open. Introduce the butterfly needle as described above. Blood flowing back slowly through the tubing indicates that the needle is in the vein.
- Care should be taken not to cannulate an artery, which is recognized by palpation. If there is a pulsatile spurting of blood, withdraw the needle and apply pressure until the bleeding stops; then look for a vein.

Inserting a butterfly needle into a scalp vein to set up an IV infusion in a young infant



Care of the cannula

Secure the cannula when introduced. This may require splinting neighbouring joints to limit the movement of the catheter. Keep the overlying skin clean and dry. Flush and fill the cannula with normal saline immediately after the initial insertion and after each injection.

Common complications

Superficial infection of the skin at the cannula site is the commonest complication. The infection may lead to thrombophlebitis, which will occlude the vein and result in fever. The surrounding skin is red and tender. Remove the cannula to reduce the risk of further spread of the infection. Apply a warm, moist compress to the site for 30 min every 6 h. If fever persists for more than 24 h, antibiotic treatment (effective against *Staphylococcus aureus*) should be given.

Intravenous drug administration through an indwelling cannula

Attach the syringe containing the IV drug to the injection port of the cannula and introduce the drug. Once all the drug has been given, flush with normal saline until all the blood has been expelled and the catheter is filled with the solution.

If infusion through a peripheral vein or scalp vein is not possible, and it is essential to give IV fluids to keep the child alive:

- set up an intraosseous infusion
- **or** use a central vein
- **or** perform a venous cut-down.

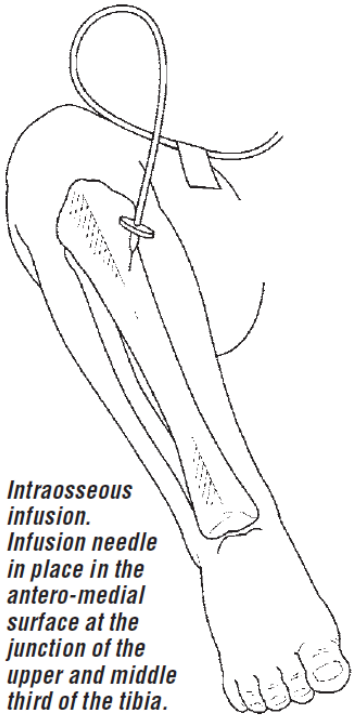
A1.2.2 Intraosseous infusion

Intraosseous infusion is a safe, simple, reliable method of giving fluid and drugs in an emergency when venous access is not possible.

The first choice for the puncture is the proximal tibia. The site for needle insertion is in the middle of the antero-medial surface of the tibia, at the junction of the upper and middle third to avoid damaging the epiphyseal plate (which is higher in the tibia) or at least 1–2 cm below the tibial tuberosity. An alternative site for needle insertion is the distal femur, 2 cm above the lateral condyle.

- Prepare the necessary equipment, i.e.:
  - bone marrow aspiration or intraosseous needles (15–18 gauge or, if not available, 21 gauge). If these are not available, bone marrow needles or large-bore hypodermic or butterfly needles can be used in young children
  - antiseptic solution and sterile gauze to clean the site

  - a sterile 5-ml syringe filled with normal saline
  - a second sterile 5-ml syringe
  - IV infusion equipment
  - sterile gloves.
- Place padding under the child's knee so that it is bent 30° from the straight (180°) position, with the heel resting on the table.
- Locate the correct position (described above and shown opposite).
- Wash the hands and put on sterile gloves.
- Clean the skin over and surrounding the site with an antiseptic solution.
- Stabilize the proximal tibia with the left hand (this hand is now not sterile) by grasping the thigh and knee above and lateral to the cannulation site, with the fingers and thumb wrapped around the knee but not directly behind the insertion site.



Intraosseous infusion. Infusion needle in place in the antero-medial surface at the junction of the upper and middle third of the tibia.

- Palpate the landmarks again with the sterile glove (right hand).
- Insert the needle at a 90° angle with the bevel pointing towards the foot. Advance the needle slowly using a gentle but firm, twisting or drilling motion.
- Stop advancing the needle when you feel a sudden decrease in resistance or when you can aspirate blood. The needle should now be fixed in the bone.
- Remove the stylet.
- Aspirate 1 ml of the marrow contents (looks like blood), using the 5-ml syringe, to confirm that the needle is in the marrow cavity.
- Attach the second 5-ml syringe filled with normal saline. Stabilize the needle and slowly inject 3 ml while palpating the area for any leakage under the skin. If no infiltration is seen, start the infusion.
- Apply dressings and secure the needle in its place.
- ***Note:*** *Failure to aspirate marrow contents does not mean that the needle is not correctly placed.*

- Monitor the infusion by the ease with which the fluid flows and by the clinical response of the patient.
- Check that the calf does not swell during the infusion.
- Stop the intraosseous infusion and remove the needle as soon as venous access is available. In any case, it should not continue for more than 8 h.

Complications include:

- Incomplete penetration of the bony cortex
  Signs: The needle is not well fixed; infiltration occurs under the skin.
- Penetration of the posterior bone cortex (more common)
  Signs: Infiltration occurs, calf becomes tense.
- Infection
  Signs: Cellulitis at the site of the infusion.

A1.2.3 Central vein cannulation

This should not be used routinely; only when IV access is urgent. Remove the cannula from a central vein as soon as possible (i.e. when IV fluid is no longer essential or when a peripheral vein can be cannulated successfully).

External jugular vein

- Hold the child securely, with the head turned to one side away from the puncture site and slightly lower than the body (15–30° head-down position). Restrain the child as necessary in this position.
- After cleaning the skin with an antiseptic solution, identify the external jugular vein as it passes over the sternocleidomastoid muscle at the junction of its middle and lower thirds. An assistant should occlude the vein to keep it distended and keep its position steady by pressing over the lower end of the visible part of the vein just above the clavicle. Pierce the skin over the vein, pointing in the direction of the clavicle. A short firm thrust will push the needle into the vein. Proceed with cannulation of the vein, as described above for a peripheral vein.

Femoral vein

- The child should be supine with the buttocks elevated 5 cm on a rolled-up towel so that the hip is slightly extended. Abduct and externally rotate the hip joint, and flex the knee. An assistant should hold the leg in this position and keep the other leg out of the way. If the child is conscious, infiltrate the area with 1% lignocaine.

- Clean the skin with an antiseptic solution to ensure that the procedure is aseptic. Palpate the femoral artery (below the inguinal ligament in the middle of the femoral triangle). The femoral vein runs medial to the femoral artery.
- Clean the skin with antiseptic. Introduce the needle at 10–20° to the skin, 1–2 cm distal to the inguinal ligament, 0.5–1 cm medial to the femoral artery.
- Venous blood will flow into the syringe when the needle is in the femoral vein.
- Proceed with cannulation of the vein by advancing the cannula at an angle of 10° to the skin.
- Stitch the cannula in place, and put a sterile occlusive dressing on the skin under the cannula and another one over the top of the cannula. Fix firmly in place with adhesive tape. It may be necessary to splint the leg to prevent flexion of the hip.
- Monitor the site closely for as long as the cannula is in place, taking care to keep the leg immobile during the infusion. A femoral line can last for up to 5 days with correct care.
- Withdraw the cannula after the IV infusion has been given, and apply firm pressure over the site for 2–3 min.

A1.2.4 Venous cut-down

This is less appropriate if speed is essential.

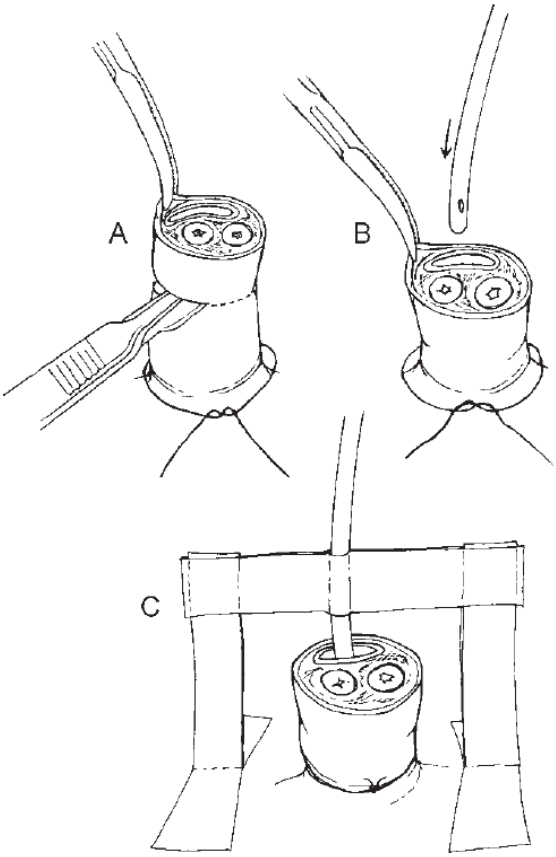
- Immoblize the child's lower leg, and clean the skin, as described above. Identify the long saphenous vein, which lies half a fingerbreadth (in the infant) or one fingerbreadth (in the older child) superior and anterior to the medial malleolus.
- Infiltrate the skin with 1% lignocaine, and make an incision through the skin perpendicular to the course of the vein. Bluntly dissect the subcutaneous tissue with haemostat forceps.
- Identify and free a 1–2-cm strip of vein. Pass a proximal and a distal ligature.
- Tie off the distal end of the vein, keeping the ties as long as possible.
- Make a small hole in the upper part of the exposed vein and insert the cannula into this, while holding the distal tie to stabilize the position of the vein.
- Secure the cannula in place with the upper ligature.
- Attach a syringe filled with normal saline, and ensure that the fluid flows freely up the vein. If it does not, check that the cannula is in the vein, or try withdrawing it slightly to improve the flow.

- Tie the distal ligature around the catheter, and then close the skin incision with interrupted sutures. Fix the cannula to the skin and cover with a sterile dressing.

A1.2.5 Umbilical vein catheterization

This procedure can be used for resuscitation or exchange transfusion and is usually possible in neonates in the first few days of life. In some circumstances, it might be possible at up to 5 days of life.

- Attach a sterile three-way tap and syringe to a sterile 5 French gauge catheter and fill with sterile 0.9% saline, then close the tap to prevent air entry (which may cause an air embolus).



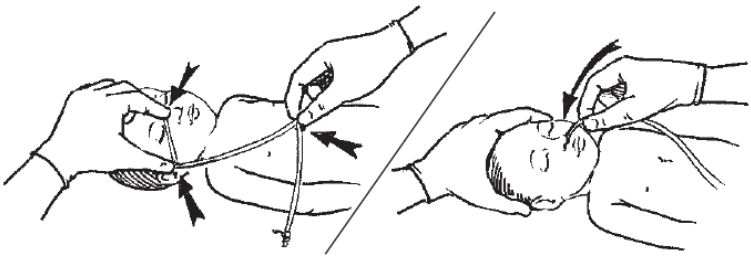
Inserting an umbilical vein catheter

A. Preparation of the umbilical cord
B. Inserting the catheter into the umbilical vein. This is the larger, thin walled structure towards the head. Note the two umbilical arteries, which are thick-walled and towards the legs of the infant.
C. Fixation of the inserted catheter, which prevents kinking

- Clean the umbilical cord and surrounding skin with an antiseptic solution, and then tie a suture around the base of the cord.
- Cut the cord 1–2 cm from the base with a sterile scalpel. Identify the umbilical vein (larger gaping vessel) and umbilical arteries (two thicker-walled vessels apart from the vein). Hold the cord (near the umbilical vein) with sterile forceps.
- Hold the near end of the catheter with sterile forceps, and advance it into the vein (it should pass easily) for 4–6 cm.
- Check that the catheter is not kinked and that blood draws back easily; if there is a block, pull gently on the cord, pull back the catheter partly, and re-insert.
- Secure with two sutures into the cord, leaving 5-cm long suture ends. Tape the suture and catheter (see diagram).
- After removal, apply pressure to the umbilical stump for 5–10 min.

A1.3 Insertion of a nasogastric tube

- Holding the tip of the tube against the child's nose, measure the distance from the nose to the ear lobe, then to the xiphisternum (epigastrium). Mark the tube at this point.
- Hold the child firmly. Lubricate the tip of the catheter with water, and pass it directly into one nostril, pushing it slowly in. It should pass easily down into the stomach without resistance. When the measured distance is reached, fix the tube with tape at the nose.
- Aspirate a small amount of stomach contents with a syringe to confirm that the tube is in place (check that it turns blue litmus paper pink). If no aspirate is obtained, inject air down the tube and listen over the abdomen with a stethoscope.



Inserting a nasogastric tube. The distance is measured from the nose to the ear and then to the epigastrium, and then the tube is inserted to the measured distance.

- If there is any doubt about the location of the tube, withdraw it and start again.
- When the tube is in place, fix a 20-ml syringe (without the plunger) to the end of the tube, and pour food or fluid into the syringe, allowing it to flow by gravity.

If oxygen therapy is to be given by nasopharyngeal catheter at the same time, pass both tubes down the same nostril and try to keep the other nostril patent by wiping away crusts and secretions, or pass the feeding tube through the mouth.

A1.4 Lumbar puncture

The following are *contraindications*:

- signs of raised intracranial pressure (unequal pupils, rigid posture or paralysis in any of the limbs or trunk, irregular breathing)
- skin infection in the area through which the needle will have to pass

If contraindications are present, the potential value of the information gained from a lumbar puncture should be carefully weighed against the risk of the procedure. If in doubt, it might be better to start treatment for suspected meningitis, and delay performing a lumbar puncture.

Position the child

There are two possible positions:

- lying on the left side (particularly for young infants)
- in the sitting position (particularly for older children)

Lumbar puncture when the child is lying on the side

- A hard surface should be used. Place the child on the side so that the vertebral column is parallel to this surface, and the transverse axis of the back is vertical (see figure next page).
- The assistant should flex the back of the child, pull the knees up towards the chest, and hold the child at the upper back between the shoulders and buttocks so that the back is bent. Hold the child firmly in this position. Make sure that the airway is not obstructed and the child can breathe normally. Take particular care in holding young infants. The assistant should not hold a young infant by the neck nor flex the neck to avoid airway obstruction.

Check anatomical landmarks

Locate the space between the third and fourth or between the fourth and fifth lumbar vertebrae. (The third lumbar vertebra is at the junction of the line between the iliac crests and the vertebral column).

Prepare the site

- Use aseptic technique. Scrub the hands and wear sterile gloves.
- Prepare the skin around the site with an antiseptic solution.
- Sterile towels may be used.
- In older children who are alert, give a local anaesthetic (1% lignocaine) infiltrated in the skin over the site.

Perform the lumbar puncture

- Use a lumbar puncture needle with stylet (22 gauge for a young infant, 20 gauge for an older infant or child; if these are not available, hypodermic needles may be used). Insert the needle into the middle of the intervertebral space, and aim the needle towards the umbilicus.



Restraining an older child in sitting position in order to carry out a lumbar puncture

- Advance the needle slowly. The needle will pass easily until it encounters the ligament between the vertebral processes. More pressure is needed to penetrate this ligament, less resistance is felt as the dura is penetrated. In young infants this decrease in resistance is not always felt, so advance the needle very carefully.
- Withdraw the stylet, and drops of CSF will pass out of the needle. If no CSF is obtained, the stylet can be reinserted and the needle advanced slightly.
- Obtain a sample of 0.5–1 ml CSF, and place in a sterile container.
- Withdraw the needle and stylet completely, and put pressure over the site for a few seconds. Put a sterile dressing over the needle puncture site.
- If the needle is introduced too far, a lumbar vein may be punctured. This will result in a 'traumatic tap', and the spinal fluid will be bloody. The needle should be withdrawn and the procedure repeated in another disc space.

A1.5 Insertion of a chest drain

Pleural effusions should be drained, except when small. It is sometimes necessary to drain both sides of the chest. You may have to drain the chest two or three times if the fluid keeps coming back.

Diagnostic procedure

- Consider giving the child sedation or light anaesthesia with ketamine.
- Wash the hands and put on sterile gloves.
- Lay the child on the back.
- Clean the skin over the chest with an antiseptic solution (for example, 70% alcohol).
- Select a point in the mid-axillary line (at the side of the chest) just below the level of the nipple (fifth intercostal space, see figure on p. 349).
- Inject about 1 ml of 1% lignocaine into the skin and subcutaneous tissue at this point.
- Insert a needle or catheter through the skin and pleura and aspirate to confirm the presence of pleural fluid. Withdraw a sample for microscopy and other tests, and place in a container.

If the fluid is clear (straw-coloured or brownish), pull out the needle or catheter after withdrawing enough fluid to relieve distress, and put a dressing over the puncture site. Consider a differential diagnosis of TB (see section 4.7.2, p. 115).

If the fluid is thin pus or cloudy (like milk), leave the catheter in place so that you can draw out more pus several times a day. Make sure you seal the end of the catheter so that no air can get in.

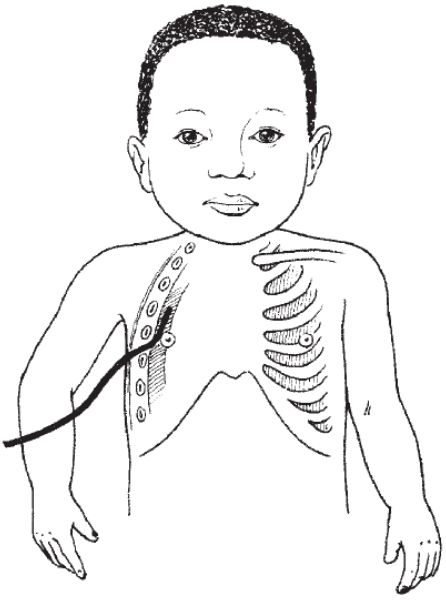
If the fluid is thick pus, which cannot pass easily through the needle or catheter, insert a chest tube (see figure).

Insertion of a chest tube

Select and prepare the site as described above.

- Make a 2–3-cm skin incision along the line of the Intercostal space, just above the rib below (to avoid damaging the vessels which lie under the lower edge of each rib).
- Use sterile forceps to push through the subcutaneous tissue just above the upper edge of the rib, and puncture the pleura.
- Pass a gloved finger into the incision and clear a path to the pleura. (This is not possible in infants.)

- Use the forceps to hold the drainage catheter (16 gauge) and introduce it into the chest for several centimetres, pointing upwards. Ensure that all drainage holes of the catheter are inside the chest.
- Connect the catheter to a collection bottle with an underwater seal.
- Suture the catheter in place, secure with tape, and apply a gauze dressing.



Insertion of a chest tube: the site is selected in the mid-axillary line in the 5th intercostal space (at the level of the nipple) on the superior aspect of the 6th rib.

Needle thoracocentesis

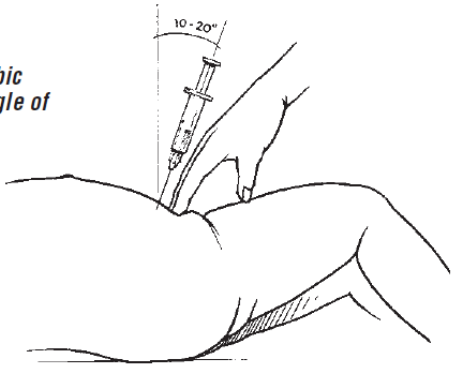
This procedure is used for a rapidly deteriorating patient who has a life-threatening tension pneumothorax (see section 4.3.3, p. 90). In such cases, immediate insertion of a chest drain may subsequently be necessary.

- Identify the second intercostal space in the mid-clavicular line on the side of the pneumothorax (the opposite side to the direction of tracheal deviation and the same side as the hyper-resonance).
- Swab the chest wall with antiseptic or an alcohol swab.
- Attach the syringe to the over-needle or intravenous cannula.
- Insert the cannula into the chest wall, just above the rib below, aspirating all the time.
- If air is aspirated, remove the needle, leaving the plastic cannula in place.
- Tape the cannula in place, and proceed to insert the chest drain as soon as possible.

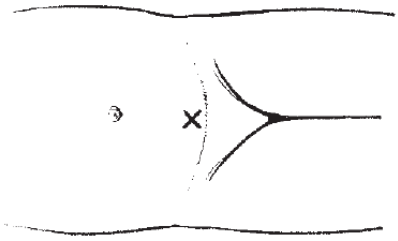
A1.6 Supra-pubic aspiration

Aspirate to a depth of 3 cm in the midline at the proximal transverse crease above the pubis with a 23-gauge needle under sterile conditions. Do this only in a child with a full bladder, which can be demonstrated by percussion. Do not use urine bags to collect urine because the specimens may become contaminated.

Have a clean urine jar ready in case the child passes urine during the procedure.



Position for carrying out suprapubic aspirate – side view. Note the angle of insertion of the needle.



Selecting the place for a suprapubic aspirate. The bladder is punctured in the midline, just above the symphysis.

A1.7 Measuring blood glucose

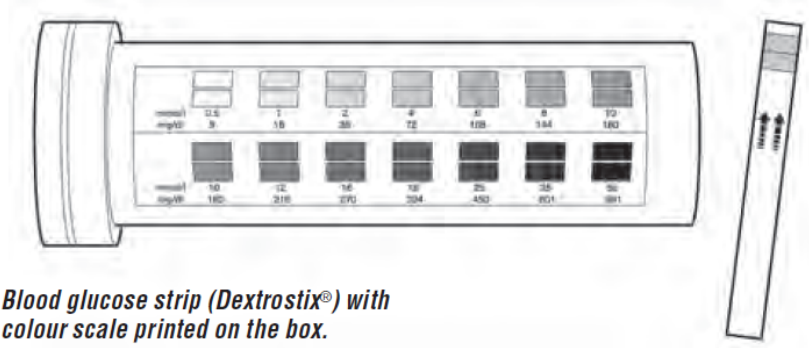
Blood glucose can be measured with a rapid diagnostic test (e.g. Dextrostix®) at the bedside, which provides an estimate of blood glucose within a few minutes. There are several brands on the market, which differ slightly in how they should be used. Instructions on the box and the package leaflet must therefore be read before using them.

Generally, a drop of blood is placed on the reagent strip and left for 30 s to 1 min, depending on the brand of strip. The blood is then wiped off, and after another fixed period (e.g. 1 further minute), the colour change on the reagent

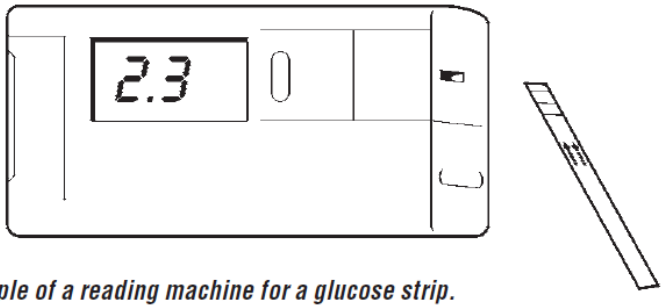
field of the strip is read and compared with a colour scale printed on the box. This allows estimation of the glucose level within a certain range, e.g. between 2 and 5 mmol/l, but does not allow exact determination.

Some strips come with an electronic reading machine, which has a battery as a power source. After the blood is wiped off, the strip is inserted into the reading machine, which provides a more accurate value.

As the reagents deteriorate with exposure to ambient humidity, they must be kept in a closed box, and the box must be closed again immediately after a strip has been taken out.



Blood glucose strip (Dextrostix®) with colour scale printed on the box.



Example of a reading machine for a glucose strip. The strip is inserted into a slot on the right side of the machine.

ANNEX 2: Drug dosages and regimens

ANNEX 2

Drug dosages and regimens

This section gives the doses of the drugs mentioned in these guidelines that are suitable for infants and children. For ease of use and to avoid having to make calculations, doses are given according to the body weight of the child. As errors in calculating drug doses are common in hospital practice worldwide, calculations should be avoided, when possible. Doses are given covering a range of body weights, from 3–29 kg. A table for neonates in the first 2 months of life is included in Chapter 3, pp. 69–72.

For some drugs (for example, antiretroviral drugs), however, it is better to calculate the **exact** individual doses on the basis of the body weight of the child, where this is possible. The drugs include those for which the exact dose is critically important to ensure a therapeutic effect or to avoid toxicity, e.g. digoxin, chloramphenicol, aminophylline and antiretroviral drugs.

For some antiretroviral drugs, the recommended dosages are often given according to the surface area of the child. A table giving approximate child surface area for different weight categories is given below to help in this calculation. The doses in the table can then be used to check that the calculated dose is approximately correct (and to check that a calculation error has not been made).

$$\text{Body surface area in } m^2 = \sqrt{\frac{\{\text{height (cm)} \times \text{weight (kg)}\}}{3600}}$$

Thus, a child weighing 10 kg and 72 cm long has a body surface area of

$$\sqrt{(10 \times 72/3600)} = 0.45 \text{ m}^2$$

Table A2.1 Drug dosage by surface area (m^2) of the child

Age or weight of child	Surface area (m^2)
Neonate (< 1 month)	0.2–0.25
Young infant (1–< 3 months)	0.25–0.35
Child 5–9 kg	0.3–0.45
Child 10–14 kg	0.45–0.6
Child 15–19 kg	0.6–0.8
Child 20–24 kg	0.8–0.9
Child 25–29 kg	0.9–1.1
Child 30–39 kg	1.1–1.3

Example: if the recommended dose is given as 400 mg/m^2 twice a day, then for a child in the weight range 15–19 kg the recommended dose range will be: (0.6–0.8) x 400 = 244–316 mg twice a day.

Drug	Dosage	Form	Dose according to body weight				
			3–< 6 kg	6–< 10 kg	10–< 15 kg	15–<20 kg	20–29 kg
Abacavir (see separate table for antiretrovirals, p. 372)							
Adrenaline							
For wheeze	0.01 ml/kg (up to a maximum of 0.3 ml) of 1:1000 solution (or 0.1 ml/kg of 1:10 000 solution) given subcutaneously with a 1-ml syringe		Calculate **exact** dose based on body weight (as rapid-acting bronchodilator)				
For severe viral croup	0.5 ml/kg of 1:1000 solution (maximum dose: 5 ml)		–	3 ml	5 ml	5 ml	5 ml
For anaphylaxis	0.15 ml of 1:1000 solution IM (0.3 ml for children > 6 years)						
Note: *Make up a 1:10 000 solution by adding 1 ml of 1:1000 solution to 9 ml of normal saline or 5% glucose*							
Aminophylline							
For asthma	Oral: 6 mg/kg	Tablets: 100 mg	¼	½	¾	1	1½
		Tablets: 200 mg	–	¼	½	½	¾
	IV: Calculate exact dose based on body weight when possible; use the doses below only when this is not possible.						
	Loading dose: IV: 5–6 mg/kg (max. 300 mg) slowly over 20–60 min	250 g/10-ml vial	1 ml	1.5 ml	2.5 ml	3.5 ml	5 ml

Drug	Dosage	Form	Dose according to body weight				
			3–< 6 kg	6–< 10 kg	10–<15 kg	15–<20 kg	20–29 kg
Aminophylline For asthma (*continued*)	**Maintenance dose:** IV: 5 mg/kg up to every 6 h		1 ml	1.5 ml	2.5 ml	3.5 ml	5 ml
	or by continuous infusion at 0.9 mg/kg per h		Calculate **exact** dose				
Give IV loading dose only if the child has not taken aminophylline or theophylline within 24 h. *For dosage and dosage intervals for apnoea in neonates and premature infants, see p. 69.*							
Amoxicillin	25 mg/kg twice a day	250 mg tablet (chewable or dispersible)	½	1	1½	2	2½
		Syrup (containing 250 mg/5 ml)	2.5 ml	5 ml	7.5 ml	10 ml	–
For pneumonia	40 mg/kg twice a day		1 2.5 ml	1½ 7.5 ml	2 10 ml	3 –	4 –
Amphotericin B For oesophageal candidiasis	0.25 mg/kg per day increasing to 1 mg/kg per day, as tolerated, by IV infusion over 6 h/day for 10–14 days	50 mg vial	–	2–8 mg	3–12 mg	4.5–18 mg	6–24 mg
Ampicillin	IM/IV: 50 mg/kg every 6 h	Vial of 500 mg mixed with 2.1 ml sterile water to give 500 mg/2.5 ml	1 ml	2 ml	3 ml	5 ml	6 ml
Note: *These oral doses are for mild disease. If oral ampicillin is required after a course of injectable ampicillin for severe disease, the oral dose must be two to four times higher than that given here.* *For dosages and dosage intervals in neonates and premature infants, see p. 69.*							

Drug	Dosage	Form	Dose according to body weight				
			3–< 6 kg	6–< 10 kg	10–<15 kg	15–<20 kg	20–29 kg
Antituberculosis antibiotics (see p. 370)							
Artemether For severe malaria	**Loading dose:** IM: 3.2 mg/kg	40 mg/1-ml ampoule 80 mg/1-ml ampoule	0.4 ml 0.2 ml	0.8 ml 0.4 ml	1.2 ml 0.6 ml	1.6 ml 0.8 ml	2.4 ml 1.2 ml
	Maintenance dose: IM: 1.6 mg/kg	40 mg/1-ml ampoule 80 mg/1-ml ampoule	0.2 ml 0.1 ml	0.4 ml 0.2 ml	0.6 ml 0.3 ml	0.8 ml 0.4 ml	1.2 ml 0.6 ml
Give the maintenance dose daily for a minimum of 24 h until the patient can take oral artemisinin-based combination therapy.							
Artemether/ lumefantrine	Oral: 2 mg/kg artemether – 12 mg/kg lumefantrine twice per day	Tablet: 20 mg artemether–120 mg lumefantrine	1	1	1	2	2
Artesunate For severe malaria	IV or IM: 2.4 mg/kg	60 mg artesumic acid (already dissolved in 0.6 ml of saline and sodium bicarbonate) in 3.4 ml of saline and glucose	0.8 ml	1.4 ml	2.4 ml	3.0 ml	5.0 ml
The IV solution should be prepared just before use. Dilute by dissolving 60 mg artesunic acid (which is already dissolved in 0.6 ml of 5% sodium bicarbonate) in 3.4 ml of 5% glucose. Give a dose at 0, 12 and 24 h and then daily until child is able to take it orally. If the patient is able to swallow, give the recommended full dose of artemisinin-based combination therapy.							
Artesunate–mefloquine	Oral: 4 mg/kg artesunate–8.3 mg/kg mefloquine once a day	Tablet: 25 mg artesunate–55 mg mefloquine	–	1	2	2	3
Not recommended for children < 5 months of age owing to limited information.							
Aspirin	Oral: 10–20 mg/kg every 4–6 h	300 mg tablet	–	¼	½	¾	1
Note: *Avoid in young children, if possible, because of the risk of Reye syndrome.*							

Drug	Dosage	Form	Dose according to body weight				
			3–< 6 kg	6–< 10 kg	10–<15 kg	15–<20 kg	20–29 kg
Benzathine penicillin – see Penicillin							
Cefotaxime	IV: 50 mg/kg every 6 h	Vial of 500 mg mixed with 2 ml sterile water or vial of 1 g mixed with 4 ml sterile water or vial of 2 g mixed with 8 ml sterile water	0.8 ml	1.5 ml	2.5 ml	3.5 ml	5 ml
For dosage and dosage intervals in neonates and premature infants, see p. 70.							
Ceftriaxone	IV: 80 mg/kg per day as a single dose given over 30 min as infusion or 3 min as IV injection	Vial of 1 g mixed with 9.6 ml sterile water to give 1 g/10 ml **or** vial of 2 g mixed with 19 ml of sterile water to give 2 g/20 ml	3 ml	6 ml	10 ml	14 ml	20 ml
For meningitis	IM/IV: 50 mg/kg every 12 h (max single dose, 4 g)		2 ml	4 ml	6 ml	9 ml	12.5 ml
	or IM/IV: 100 mg/kg		4 ml	8 ml	12 ml	18 ml	25 ml
For dosage and dosage intervals in neonates and premature infants, see p. 70.							
Cefalexin	12.5 mg/kg four times a day	250 mg tablet	¼	½	¾	1	1¼

Drug	Dosage	Form	Dose according to body weight				
			3–< 6 kg	6–< 10 kg	10–< 15 kg	15–< 20 kg	20–29 kg
Chloramphenicol For meningitis	*Calculate exact dose based on body weight. Use the doses below only if this is not possible.*						
	IV: 25 mg/kg every 6 h (max, 1 g per dose)	Vial of 1 g mixed with 9.2 ml sterile water to give 1 g/10 ml	0.75–1.25 ml	1.5–2.25 ml	2.5–3.5 ml	3.75–4.75 ml	5–7.25 ml
For cholera	IM: 20 mg/kg every 6 h for 3 days	Vial of 1 g mixed with 3.2 ml sterile water to give 1 g/4 ml	0.3–0.5 ml	0.6–0.9 ml	1–1.4 ml	1.5–1.9 ml	2–2.9 ml
For other conditions	Oral: 25 mg/kg every 8 h	125 mg/5 ml suspension (palmitate)	3–5 ml	6–9 ml	10–14 ml	15–19 ml	–
	(maximum 1 g per dose)	250 mg capsule	–	–	1	1½	2
Phenobarbital reduces and phenytoin increases chloramphenicol levels when given together.							
Chloramphenicol, oily (for treatment of meningococcal meningitis during epidemics)	100 mg/kg single dose; max, 3 g	IM: vial of 0.5 g in 2 ml	1.2–2 ml	2.4–3.6 ml	4–5.6 ml	6–7.6 ml	8–11.6 ml
Chlorphenamine	IM/IV or SC:	10 mg in 1 ml	0.1 ml	0.2 ml	0.3 ml	0.5 ml	0.6 ml
	0.25 mg/kg once (can be repeated up to four times in 24 h	IV solution					
	Oral: two or three times daily	Tablet: 4 mg	–	–	–	–	½

Drug	Dosage	Form	Dose according to body weight				
			3–< 6 kg	6–< 10 kg	10–<15 kg	15–<20 kg	20–29 kg
Ciprofloxacin	Oral: 10-20 mg/kg per dose given twice a day for 5 days (max, 500 mg per dose)	100 mg tablet	½	1	1½	2	3
		250 mg tablet	¼	½	½	1	1½
Cloxacillin or flucloxacillin or oxacillin	IV: 25–50 mg/kg every 6 h	Vial of 500 mg mixed with 8-ml dose in sterile water to give 500 mg/10 ml	2–(4) ml	4–(8) ml	6–(12) ml	8–(16) ml	12–(24) ml
	IM: 25–50 mg/kg every 6 h	Vial of 250 mg mixed with 1.3 ml sterile water to give 250 mg/1.5 ml	0.6 (1.2) ml	1 (2) ml	1.8 (3.6) ml	2.5 (5) ml	3.75 (7.5) ml
		250 mg capsule	half (1)	1 (2)	1 (2)	2 (3)	2 (4)
For treating abscesses	15 mg/kg every 6 h	250-mg capsule	¼	½	1	1½	2½
For dosage and dosage intervals in neonates and premature infants, p. 70.							
Co-trimoxazole (trimethoprim-sulfamethoxazole)	4 mg/kg trimethoprim and 20 mg/kg sulfamethoxazole twice a day	Oral: adult tablet (80 mg trimethoprim + 400 mg sulfamethoxazole)	¼	½	1	1	1
		Oral: paediatric tablet (20 mg trimethoprim + 100 mg sulfamethoxazole)	1	2	3	3	4

Drug	Dosage	Form	Dose according to body weight				
			3–< 6 kg	6–< 10 kg	10–<15 kg	15–<20 kg	20–29 kg
Co-trimoxazole (trimethoprim-sulfamethoxazole *(continued)*		Oral: syrup (40 mg trimethoprim + 200 mg sulfamethoxazole per 5 ml)	2 ml	3.5 ml	6 ml	8.5 ml	—
Note: *For interstitial pneumonia in children with HIV, give 8 mg/kg trimethoprim and 40 mg/kg sulfamethoxazole three times a day for 21 days. For an infant < 1 month, give co-trimoxazole (half paediatric tablet or 1.25 ml syrup) twice a day. Avoid co-trimoxazole in neonates who are premature or jaundiced.*							
Deferoxamine For iron poisoning	15 mg/kg per h IV to max of 80 mg/kg in 24 h, or IM: 50 mg/kg every 6 h. Maximum dose, 6 g/day	500-mg ampoule	2	2	2	2	2
Dexamethasone For severe viral croup	Oral: 0.6 mg/kg single dose	0.5-mg tablets					
		IM: 5 mg/ml	0.5 ml	0.9 ml	1.4 ml	2 ml	3 ml
For meningitis	IV: 0.15 mg/kg/dose every 6 h for the first 2–4 days						
Diazepam For convulsions	Rectal: 0.5 mg/kg	10 mg/2 ml solution	0.4 ml	0.75 ml	1.2 ml	1.7 ml	2.5 ml
	IV: 0.2–0.3 mg/kg		0.25 ml	0.4 ml	0.6 ml	0.75 ml	1.25 ml
For sedation before procedures	0.1–0.2 mg/kg IV						
Give phenobarbital (20 mg/kg IV or IM) instead of diazepam to neonates. If convulsions continue, give 10 mg/kg IV or IM after 30 min. The maintenance dose of oral phenobarbital is 2.5–5 mg/kg.							

Drug	Dosage	Form	Dose according to body weight				
			3–< 6 kg	6–< 10 kg	10–<15 kg	15–<20 kg	20–29 kg
Digoxin	These doses are for oral digoxin. Give as an initial loading dose followed by twice daily maintenance doses, starting 6 h after the loading dose:						
	Loading dose: 15 µg/kg, once only	62.5-µg tablets	¾–1	1½–2	2½–3½	3½–4½	–
		125-µg tablets	–	–	1-1½	1¾–2	2½–3
	Maintenance dose: (Start 6 h after loading dose) 5 µg/kg every 12 h (max, 250 µg per dose)	62.5-µg tablets	¼–½	½–¾	¾–1	1¼–1½	1½–2¼
Dobutamine For treatment of shock that is unresponsive to fluids	2–20 µg/kg per min	250 mg/20 ml ampoule Dilute to 250 mg in 250 ml of 0.9% sodium chloride with 5% glucose to 1000 µg/ml	Calculate **exact** dose based on body weight and required rate of infusion.				
Diluted solutions may be stored for a maximum of 24 h.							
Dopamine For treatment of shock that is unresponsive to fluids	2–20 µg/kg per min	200 mg/5 ml ampoule Dilute to 250 mg in 250 ml of 0.9% sodium chloride with 5% glucose to 1000 µg/ml	Calculate **exact** dose based on body weight and required rate of infusion.				
Efavirenz (see separate table for antiretrovirals, p. 372)							
Erythromycin (estolate)	Oral: 12.5 mg/kg four times a day for 3 days	250-mg tablet	¼	½	1	1	1½
Must not be given with theophylline (aminophylline) because of risk of serious adverse reactions.							

Drug	Dosage	Form	Dose according to body weight				
			3–< 6 kg	6–< 10 kg	10–< 15 kg	15–<20 kg	20–29 kg
Fentanyl	IV injection: 1-4 µg/kg every 2–4 h	Injection: 50 µg/ml	–	Calculate **exact** dose based on body weight, and tailor dose to relieve pain.			
	Infusion: initial IV dose 1–2 µg/kg, then 0.5–1 µg/kg per h		–	Calculate **exact** dose based on body weight and required rate of infusion.			
Fluconazole	3–6 mg/kg once a day	50 mg/5 ml oral suspension	–	–	5 ml	7.5 ml	12.5 ml
For cryptococcal meningitis	6–12 mg/kg once a day	50-mg capsule	–	–	1	1–2	2–3
Flucloxacillin (see Cloxacillin)							
Furazolidone	1.25 mg/kg 4 times a day for 3 days	Oral: 100-mg tablet	–	–	¼	¼	¼
Furosemide (frusemide) For cardiac failure	Oral or IV: 1–2 mg/kg every 12 h	20-mg tablets IV 10 mg/ml	¼–½	½–1	½–1	1–2	1¼–2½
			0.4–0.8 ml	0.8–1.6 ml	1.2–2.4 ml	1.7–3.4 ml	2.5–5 ml
Gentamicin	Calculate **exact** dose based on body weight, and use the doses below only when this is not possible.						
	7.5 mg/kg once a day	IM/IV: vial containing 20 mg (2 ml at 10 mg/ml) undiluted	2.25–3.75 ml	4.5–6.75 ml	7.5–10.5 ml	–	–
		IM/IV: vial containing 80 mg (2 ml at 40 mg/ml) mixed with 6 ml sterile water	2.25–3.75 ml	4.5–6.75 ml	7.5–10.5 ml	–	–

Drug	Dosage	Form	Dose according to body weight				
			3–< 6 kg	6–< 10 kg	10–<15 kg	15–<20 kg	20–29 kg
Gentamicin *(continued)*		IM/IV: vial containing 80 mg (2 ml at 40 mg/ml) undiluted	0.5–0.9 ml	1.1–1.7 ml	1.9–2.6 ml	2.8–3.5 ml	3.75–5.4 ml
Risk for adverse effects when given with theophylline. In administering an aminoglycoside (gentamicin, kanamycin), it is preferable to avoid use of undiluted 40 mg/ml gentamicin.							
For dosage and dosage intervals in neonates and premature infants, see p. 71.							
Gentian violet: Topical application to skin							
Hydromorphone	0.1–0.2 mg/kg every 4 h for two or three doses, then every 6–12 h	Tablet: 2 or 4 mg	–	Calculate **exact** dose based on body weight, and tailor dose to relieve pain.			
		Oral liquid: 1 mg/ml	–				
	0.015–0.02 mg/kg every 3–6 h	IV: 1 or 2 or 4 mg/ml	–	Calculate **exact** dose based on body weight and required rate of infusion.			
Ibuprofen	5–10 mg/kg orally every 6–8 h to a max total daily dose of 40 mg/kg	200-mg tablet	–	¼	¼	½	¾
		400-mg tablet	–	–	–	¼	½
Iron	Once a day for 14 days	Iron–folate tablet (ferrous sulfate 200 mg + 250 µg folate = 60 mg elemental iron	–	–	½	½	1
		Iron syrup (ferrous fumarate, 100 mg per 5 ml = 20 mg/ml elemental iron)	1 ml	1.25 ml	2 ml	2.5 ml	4 ml

Drug	Dosage	Form	Dose according to body weight 3–< 6 kg	6–< 10 kg	10–< 15 kg	15–<20 kg	20–29 kg
Kanamycin	Calculate **exact** dose based on body weight. Use the doses below only if this is not possible.						
	IM/IV: 20 mg/kg once a day	250 mg vial (2 ml at 125 mg/ml)	0.5–0.8 ml	1–1.5 ml	1.6–2.2 ml	2.4–3.0 ml	3.2–4.6 ml
For dosage and dosage intervals in neonates and premature infants, see p. 71.							
Ketamine	Calculate **exact** dose based on body weight.						
For anaesthesia in major procedures	IM: Loading dose: 5–8 mg/kg		20–35 mg	40–60 mg	60–100 mg	80–140 mg	125–200 mg
	IM: Further dose: 1–2 mg/kg (if required)		5–10 mg	8–15 mg	12–25 mg	15–35 mg	25–50 mg
	IV: Loading dose: 1–2 mg/kg		5–10 mg	8–15 mg	12–25 mg	15–35 mg	25–50 mg
	IV: Further dose: 0.5–1 mg/kg(if required)		2.5–5 mg	4–8 mg	6–12 mg	8–15 mg	12–25 mg
For light anaesthesia in minor procedures	IM: 2–4 mg/kg						
	IV: 0.5–1 mg/kg						
Dose details and method of administration are given on p. 258.							
Lamivudine (see separate table for antiretrovirals, p. 372)							
Lidocaine	Apply topically (see p. 307) Local injection: 4–5 mg/kg per dose as local anaesthetic						
Mebendazole	100 mg twice a day for 3 days	100-mg tablet	–	–	1	1	1
	500 mg once only	500-mg tablet	–	–	1	1	1
Not recommended for children < 5 months of age owing to limited information.							

Drug	Dosage	Form	Dose according to body weight				
			3–< 6 kg	6–< 10 kg	10–<15 kg	15–<20 kg	20–29 kg
Metoclopramide For nausea and vomiting	0.1–0.2 mg/kg every	10-mg tablets	–	–	¼	¼	½
	8 h as required (maximum dose: 10 mg/dose)	Injection: 5 mg/ml	–	–	0.5 ml	0.7 ml	1 ml
Metronidazole	Oral: 7.5 mg/kg three times a day for 7 days	200-mg tablet	–	¼	½	½	1
		400-mg tablet	–	–	¼	¼	½
For the treatment of giardiasis, and for amoebiasis, 10 mg/kg.							
Morphine	Calculate **exact** dose based on weight of the child. Oral: 0.2–0.4 mg/kg every 4–6 h; increase if necessary for severe pain IM: 0.1–0.2 mg/kg every 4–6 h IV: 0.05–0.1 mg/kg every 4–6 h, or 0.005–0.01 mg/kg per h by IV infusion						
Nevirapine (see separate table for antiretrovirals, p. 373)							
Nystatin	Oral: 100 000–200 000 U into the mouth	Oral suspension 100 000 units/ml	1–2 ml	1–2 ml	1–2 ml	1–2 ml	1–2 ml
Oxacillin (see Cloxacillin)							
Paracetamol	10–15 mg/kg, up to six times a day	100-mg tablet	–	1	1	2	3
		500-mg tablet	–	¼	¼	½	½

Drug	Dosage	Form	Dose according to body weight				
			3–< 6 kg	6–< 10 kg	10–< 15 kg	15–<20 kg	20–29 kg
PENICILLIN							
Benzathine benzylpenicillin	50 000 U/kg once a day	IM: vial of 1 200 000 U mixed with 4 ml sterile water	0.5 ml	1 ml	2 ml	3 ml	4 ml
Benzylpenicillin (penicillin G) General dosage	IV: 50 000 U/kg every 6 h						
		Vial of 600 mg mixed with 9.6 ml sterile water to give 1 000 000 U/10 ml	2 ml	3.75 ml	6 ml	8.5 ml	12.5 ml
	IM:	Vial of 600 mg (1 000 000 U) mixed with 1.6 ml sterile water to give 1 000 000 U/2 ml	0.4 ml	0.75 ml	1.2 ml	1.7 ml	2.5 ml
For meningitis	100 000 U/kg every 6 h	IV	4 ml	7.5 ml	12 ml l	17 ml	25 ml
		IM	0.8 ml	1.5 ml	2.5 ml	3.5 ml l	5 m
For dosage and dosage intervals in neonates and premature infants, see p. 71.							
Procaine benzylpenicillin	IM: 50 000 U/kg once a day	3-g vial (3 000 000 U) mixed with 4 ml sterile water	0.25 ml	0.5 ml	0.8 ml	1.2 ml	1.7 ml
Phenobarbital	IM: Loading dose: 15 mg/kg	200 mg/ml solution	0.4 ml	0.6 ml	1.0 ml	1.5 ml	2.0 ml
	Oral or IM: Maintenance dose: 2.5–5 mg/kg		0.1 ml	0.15 ml	0.25 ml	0.35 ml	0.5 ml
Give phenobarbital (20 mg/kg IV or IM) instead of diazepam to neonates. If convulsions continue, give 10 mg/kg IV or IM after 30 min.							

Drug	Dosage	Form	Dose according to body weight				
			3–< 6 kg	6–< 10 kg	10–< 15 kg	15–< 20 kg	20–29 kg
Potassium Chloride	2–4 mmol/kg per day		Calculate **exact** dose				
Prednisolone	Oral: 1 mg/kg twice a day for 3 days	5-mg tablet	1	1	2	3	5
1 mg prednisolone is equivalent to 5 mg hydrocortisone or 0.15 mg dexamethasone.							
Quinine (mg/kg expressed as mg of quinine hydrochloride salt)	IV: Loading dose: 20 mg salt/kg given slowly over 2–4 h after dilution in 10 ml/kg of IV fluid		Loading dose is double the maintenance dose given below. Infusion rate should not exceed a total of 5 mg quinine dihydrochloride salt/kg per h.				
	IV: Maintenance dose: 10 mg salt/kg given slowly over 2 h after dilution in 10 ml/kg of IV fluid	IV (undiluted): quinine dihydrochloride injection 150 mg/ml (in 2-ml ampoules)	0.3 ml	0.6 ml	1 ml	1.2 ml	2 ml
		IV (undiluted): quinine dihydrochloride injection 300 mg/ml (in 2-ml ampoules)	0.2 ml	0.3 ml	0.5 ml	0.6 ml	1 ml
	If IV infusion is not possible, quinine dihydrochloride can be given at the same dosages IM	IM quinine dihydrochloride (diluted): in normal saline to a concentration of 60 mg salt/ml	1 ml	1.5 ml	2.5 ml	3 ml	5 ml
		Oral: quinine sulfate 200-mg tablet	¼	½	¾	1	1½

Drug	Dosage	Form	Dose according to body weight				
			3–< 6 kg	6–< 10 kg	10–<15 kg	15–<20 kg	20–29 kg
Quinine *(continued)*		Oral: quinine sulfate 300-mg tablet	–	–	½	½	1
Note: *At 8 h after the start of the loading dose, give the maintenance dose listed here over 2 h. Repeat every 8 h. Give a full dose of oral artemisinin combination therapy treatment when the child is able to take orally to complete treatment.*							
Ritonavir (see Lopinavir/ritonavir in separate table for antiretrovirals, p. 373)							
Salbutamol	**Inhaler with spacer:** two doses contain 200 µg	Metered dose inhaler containing 200 doses					
	Nebulizer: 2.5 mg/dose	5 mg/ml solution, 2.5 mg in 2.5 ml single-dose units					
Silver sulfadiazine: apply topically to area of affected skin							
Spectinomycin For neonatal ophthalmia	IM: 25 mg/kg single dose (max, 75 mg)	2-g vial in 5 ml diluent	0.25 ml	–	–	–	–
Tetracaine, adrenaline, cocaine: Apply topically before painful procedures.							
Tetracycline	12.5 mg/kg four times a day for 3 days	250-mg tablet	–	½	½	1	1
Give to children only for treatment of cholera, because permanently stains teeth.							
Vitamin A	Once a day for 2 days	200 000 IU capsule	–	½	1	1	1
		100 000 IU capsule	½	1	2	2	2
		50 000 IU capsule	1	2	4	4	4
Zidovudine (see separate table for antiretrovirals, p. 372)							

Antituberculous antibiotics

Calculate **exact** dose based on body weight

Essential anti-TB drug (abbreviation)	Mode of action	Daily dose: mg/kg (range)
Isoniazid (H)	Bactericidal	10 (10–15)
Rifampicin (R)	Bactericidal	15 (10–20)
Pyrazinamide (Z)	Bactericidal	35 (30–40)
Ethambutol (E)	Bacteriostatic	20 (15–25)
Streptomycin (S): use only for MDR TB treatment	Bactericidal	15 (12–18)

Antiretrovirals

Drug	Dosage	Form	Dose according to surface area or body weight (morning and evening) 3–5.9 kg	6–9.9 kg	10–13.9 kg	14–19.9 kg	20–24.9 kg	25–34.9 kg
Fixed-dose combinations								
Zidovudine/ lamivudine (AZT/3TC)	AZT: 180–240 mg/ m^2 twice a day 3TC: 4 mg/kg twice a day	AZT 60 mg + 3TC 30 mg	1	1.5	2	2.5	3	–
		AZT 300 mg + 3TC 150 mg	–	–	–	–	–	1
Zidovudine/ lamivudine /nevirapine (AZT/3TC/ NVP)	AZT: 180–240 mg/ m^2 twice a day 3TC: 4 mg/kg twice a day NVP: 160–200 mg/m^2	AZT 60 mg + 3TC 30 mg + NVP 50 mg	1	1.5	2	2.5	3	–
		AZT 300 mg + 3TC 150 mg + NVP 200 mg	–	–	–	–	–	1

Drug	Dosage	Form	Dose according to surface area or body weight (morning and evening)					
			3–5.9 kg	6–9.9 kg	10–13.9 kg	14–19.9 kg	20–24.9 kg	25–34.9 kg
Fixed-dose combinations (*continued*)								
Abacavir/ zidovudine / lamivudine (ABC/ AZT/3TC)	ABC: 8 mg/kg twice a day AZT: 180–240 mg/ m^2 twice a day 3TC: 4 mg/kg twice a day	ABC 60 mg + AZT 60 mg + 3TC 30 mg	1	1.5	2	2.5	3	–
		ABC 300 mg + AZT 300 mg + 3TC 150 mg	–	–	–	–	–	1
Abacavir/ lamivudine (ABC/3TC)	Abacavir: 8 mg/kg twice a day Lamivudine: 4 mg/kg twice a day	Paediatric: ABC 60 mg + 3TC 30 mg	1	1.5	2	2.5	3	–
		Adult: ABC 600 mg + 3TC 300 mg	–	–	–	–	–	½

Adult ABC/3TC fixed-dose combination tablets are not scored; a tablet cutter would be required to divide these tablets. Consider giving one tablet daily.

Drug	Dosage	Form	Dose according to surface area or body weight (morning and evening)					
			3–5.9 kg	6–9.9 kg	10–13.9 kg	14–19.9 kg	20–24.9 kg	25–34.9 kg
Nucleoside reverse transcriptase Inhibitors (NRTIs)								
Abacavir (ABC)	8 mg/kg per dose twice a day	Liquid: 20 mg/ml	3 ml	4 ml	6 ml	–	–	–
		Tablet: 60 mg	1	1½	2	2½	3	–
		Tablet: 300 mg	–	–	–	½	1	1
Lamivudine (3TC)	4 mg/kg per dose twice a day	Liquid: 10 mg/ml	3 ml	4 ml	6 ml	–	–	–
		Tablet: 150 mg	–	–	–	½	1	1
Tenofovir (TDF)	8 mg/kg once a day (max 300 mg)	Oral powder scoops	–	–	2.5	3.5	4.5	6.0
		Tablet: 150 mg	–	–	–	1	–	–
		Tablet: 200 mg	–	–	–	–	1	–
		Tablet: 250 mg	–	–	–	–	–	1
Zidovudine (AZT or ZDV)	Oral: 180–240 mg/m^2 per dose given twice a day (total daily dose 360–480 mg/m^2)	Liquid: 10 mg/ml	6 ml	9 ml	–	–	–	–
		Tablet: 60 mg	1	1½	2	2½	3	–
Non-nucleoside reverse transcriptase Inhibitors (NNRTIs)								
Efavirenz	15 mg/kg per day once a day	Tablet: 200 mg	Insufficient data on dosing for children < 3 years or weighing < 10 kg		1 daily	1.5 daily	1.5 daily	2 daily

Higher doses of LPV/RTV may be required when co-administered with enzyme-inducing drugs such as nevirapine, efavirenz, fos-amprenavir and rifampicin.

Drug	Dosage	Form	Dose according to surface area or body weight (morning and evening)					
			3–5.9 kg	6–9.9 kg	10–13.9 kg	14–19.9 kg	20–24.9 kg	25–34.9 kg
Nevirapine	160–200 mg/m² to maximum of 200 mg twice a day	Liquid: 10 mg/ml	5 ml	8 ml	10 ml	–	–	–
		Tablet: 50 mg	1	1½	2	2½	3	
		Tablet: 200 mg	–	–	–	½	1 & ½	1

Divided into unequal doses, give one dose in the morning and the other in the evening.

Drug	Dosage	Form	Dose according to surface area or body weight (morning and evening)					
			3–5.9 kg	6–9.9 kg	10–13.9 kg	14–19.9 kg	20–24.9 kg	25–34.9 kg
Protease inhibitors								
Lopinavir/ritonavir (LPV/RTV)	230–350 mg/m² twice a day	Liquid: (LPV 80 mg + RTV 20 mg)/ml	1 or 1.5 ml	1.5 ml	2 ml	2.5 ml	3 ml	–
		Paediatric tablet: LPV 100 mg/RTV 25 mg	–	–	2	2	2	3
		Adult tablet: LPV 200 mg/RTV 50 mg	–	–	1	1	1	1½

Higher doses of LPV/RTV may be required when co-administered with enzyme-inducing drugs such as nevirapine, efavirenz, fos-amprenavir and rifampicin.

ANNEX 3: Eguipment Sizes

ANNEX 3

Equipment sizes

Appropriate sizes of paediatric equipment according to age (weight) of child

Equipment	0–5 months (3–6 kg)	6–12 months (4–9 kg)	1–3 years (10–15 kg)	4–7 years (16–20 kg)
AIRWAY AND BREATHING				
Laryngoscope	Straight blade	Straight blade	Child Macintosh	Child Macintosh
Uncuffed tracheal tube	2.5–3.5	3.5–4.0	4.0–5.0	5.0–6.0
Stylet	Small	Small	Small/ medium	Medium
Suction catheter (French gauge)	6	8	10/12	
CIRCULATION				
IV cannula	24/22	22	22/18	20/16
Central venous cannula	20	20	18	18
OTHER EQUIPMENT				
Nasogastric tube[a]	8	10	10–12	12
Urinary catheter[a]	5 feeding tube	5 feeding tube/F8	Foley 8	Foley 10

[a] Sizes in French gauge or Charrière, which are equivalent and indicate the circumference of the tube in millimetres.

ANNEX 4

Intravenous fluids

The following table gives the composition of IV fluids that are commercially available and commonly used for neonates, infants and children. For a decision on which fluid to use in particular circumstances, see the disease-specific chapters, e.g. for shock (pp. 13–14), for neonates (p. 57), for severely malnourished children (p. 204), for surgical procedures (p. 261) and for general supportive therapy (p. 304). Please note that none of the fluids contains sufficient calories for the long-term nutritional support of children, but that some fluids contain less than others. When feed and fluids can be given by mouth or nasogastric tube, this is the safest, preferable route.

	Composition						
	Na+	K+	Cl–	Ca++	Lactate	Glucose	Calories
IV fluid	mmol/l	mmol/l	mmol/l	mmol/l	mmol/l	g/l	cal/l
Ringer's lactate (Hartmann's)	130	5.4	112	1.8	27	–	–
Normal saline (0.9% NaCl)	154	–	154	–	–	–	–
10% glucose	–	–	–	–	–	100	400
0.45 NaCl/5% glucose	77	–	77	–	–	50	200
Darrow's solution	121	35	103	–	53	–	–
Half-strength Darrow with 5% glucose[a]	61	17	52	–	27	50	200
Half-strength Ringer's lactate with 5% glucose	65	2.7	56	1	14	50	200
0.18% NaCl/4% glucose[b]	31	–	31	–	–	40	160
5% glucose[b]	–	–	–	–	–	50	200

[a] Half-strength Darrow's solution often comes without glucose, and glucose must be added before use.

[b] These fluids can be used mainly in the first few days of life but not in other infants or children.

A4.1 Choice of intravenous fluids

The risk for hyponatraemia may be increased with use of solutions containing very low sodium in paediatric patients, in comparison with fluids with a sodium content of 75–150 mmol/litre. Solutions containing low sodium, such as 0.18% sodium chloride with 4% glucose, or 5% glucose in water, should not be used for rehydration or fluid maintenance. Appropriate sodium-containing IV maintenance fluids should contain glucose to avoid hypoglycaemia and starvation ketosis in children who are unable to feed orally or by nasogastric tube.

- **Resuscitation:** Children who are severely dehydrated or with signs of shock should be resuscitated with isotonic IV solutions (normal saline 0.9% or Ringer's lactate).
- **Intravenous maintenance fluid:** Children who require IV fluids for maintenance should be managed with Ringer's lactate solution with 5% dextrose or 0.9% normal saline with 5% glucose or half-normal saline (0.45% sodium chloride) with 5% glucose.

ANNEX 5

Assessing nutritional status

A5.1 Calculating a child's weight-for-age

To calculate a child's weight-for-age, use the tables below or the charts on pp. 384–5.

In the table:

- Locate the appropriate table for boys or girls.
- Locate the row containing the child's age in the left column.
- Note where the child's weight lies with respect to the weights recorded in this row.
- Look up the column to read the weight-for-age of the child.

Example 1: Boy aged 5 months weighing 5.3 kg. His weight-for-age is –3 SD.

Example 2: Girl aged 27 months weighing 6.5 kg. Her weight-for-age is < –3 SD.

The lines in the charts on pp. 384–5 correspond to –2 (low weight-for-age) and –3 SD (very low weight-for-age). Please note that you should use tables in section A5.2, pp. 386–402 for weight-for-height to determine whether a child has severe acute malnutrition.

Table A5.1.1 Weight-for-age from birth to 5 years: Boys

Months	–3 SD	–2 SD	–1 SD	Median	1 SD	2 SD	3 SD
0	2.1	2.5	2.9	3.3	3.9	4.4	5.0
1	2.9	3.4	3.9	4.5	5.1	5.8	6.6
2	3.8	4.3	4.9	5.6	6.3	7.1	8.0
3	4.4	5.0	5.7	6.4	7.2	8.0	9.0
4	4.9	5.6	6.2	7.0	7.8	8.7	9.7
5	5.3	6.0	6.7	7.5	8.4	9.3	10.4
6	5.7	6.4	7.1	7.9	8.8	9.8	10.9
7	5.9	6.7	7.4	8.3	9.2	10.3	11.4
8	6.2	6.9	7.7	8.6	9.6	10.7	11.9

Months	−3 SD	−2 SD	−1 SD	Median	1 SD	2 SD	3 SD
9	6.4	7.1	8.0	8.9	9.9	11.0	12.3
10	6.6	7.4	8.2	9.2	10.2	11.4	12.7
11	6.8	7.6	8.4	9.4	10.5	11.7	13.0
12	6.9	7.7	8.6	9.6	10.8	12.0	13.3
13	7.1	7.9	8.8	9.9	11.0	12.3	13.7
14	7.2	8.1	9.0	10.1	11.3	12.6	14.0
15	7.4	8.3	9.2	10.3	11.5	12.8	14.3
16	7.5	8.4	9.4	10.5	11.7	13.1	14.6
17	7.7	8.6	9.6	10.7	12.0	13.4	14.9
18	7.8	8.8	9.8	10.9	12.2	13.7	15.3
19	8.0	8.9	10.0	11.1	12.5	13.9	15.6
20	8.1	9.1	10.1	11.3	12.7	14.2	15.9
21	8.2	9.2	10.3	11.5	12.9	14.5	16.2
22	8.4	9.4	10.5	11.8	13.2	14.7	16.5
23	8.5	9.5	10.7	12.0	13.4	15.0	16.8
24	8.6	9.7	10.8	12.2	13.6	15.3	17.1
25	8.8	9.8	11.0	12.4	13.9	15.5	17.5
26	8.9	10.0	11.2	12.5	14.1	15.8	17.8
27	9.0	10.1	11.3	12.7	14.3	16.1	18.1
28	9.1	10.2	11.5	12.9	14.5	16.3	18.4
29	9.2	10.4	11.7	13.1	14.8	16.6	18.7
30	9.4	10.5	11.8	13.3	15.0	16.9	19.0
31	9.5	10.7	12.0	13.5	15.2	17.1	19.3
32	9.6	10.8	12.1	13.7	15.4	17.4	19.6
33	9.7	10.9	12.3	13.8	15.6	17.6	19.9
34	9.8	11.0	12.4	14.0	15.8	17.8	20.2
35	9.9	11.2	12.6	14.2	16.0	18.1	20.4
36	10.0	11.3	12.7	14.3	16.2	18.3	20.7
37	10.1	11.4	12.9	14.5	16.4	18.6	21.0
38	10.2	11.5	13.0	14.7	16.6	18.8	21.3
39	10.3	11.6	13.1	14.8	16.8	19.0	21.6

Months	–3 SD	–2 SD	–1 SD	Median	1 SD	2 SD	3 SD
40	10.4	11.8	13.3	15.0	17.0	19.3	21.9
41	10.5	11.9	13.4	15.2	17.2	19.5	22.1
42	10.6	12.0	13.6	15.3	17.4	19.7	22.4
43	10.7	12.1	13.7	15.5	17.6	20.0	22.7
44	10.8	12.2	13.8	15.7	17.8	20.2	23.0
45	10.9	12.4	14.0	15.8	18.0	20.5	23.3
46	11.0	12.5	14.1	16.0	18.2	20.7	23.6
47	11.1	12.6	14.3	16.2	18.4	20.9	23.9
48	11.2	12.7	14.4	16.3	18.6	21.2	24.2
49	11.3	12.8	14.5	16.5	18.8	21.4	24.5
50	11.4	12.9	14.7	16.7	19.0	21.7	24.8
51	11.5	13.1	14.8	16.8	19.2	21.9	25.1
52	11.6	13.2	15.0	17.0	19.4	22.2	25.4
53	11.7	13.3	15.1	17.2	19.6	22.4	25.7
54	11.8	13.4	15.2	17.3	19.8	22.7	26.0
55	11.9	13.5	15.4	17.5	20.0	22.9	26.3
56	12.0	13.6	15.5	17.7	20.2	23.2	26.6
57	12.1	13.7	15.6	17.8	20.4	23.4	26.9
58	12.2	13.8	15.8	18.0	20.6	23.7	27.2
59	12.3	14.0	15.9	18.2	20.8	23.9	27.6
60	12.4	14.1	16.0	18.3	21.0	24.2	27.9

Table A5.1.2 Weight-for-age from birth to 5 years: Girls

Months	–3 SD	–2 SD	–1 SD	Median	1 SD	2 SD	3 SD
0	2.0	2.4	2.8	3.2	3.7	4.2	4.8
1	2.7	3.2	3.6	4.2	4.8	5.5	6.2
2	3.4	3.9	4.5	5.1	5.8	6.6	7.5
3	4.0	4.5	5.2	5.8	6.6	7.5	8.5
4	4.4	5.0	5.7	6.4	7.3	8.2	9.3
5	4.8	5.4	6.1	6.9	7.8	8.8	10.0
6	5.1	5.7	6.5	7.3	8.2	9.3	10.6

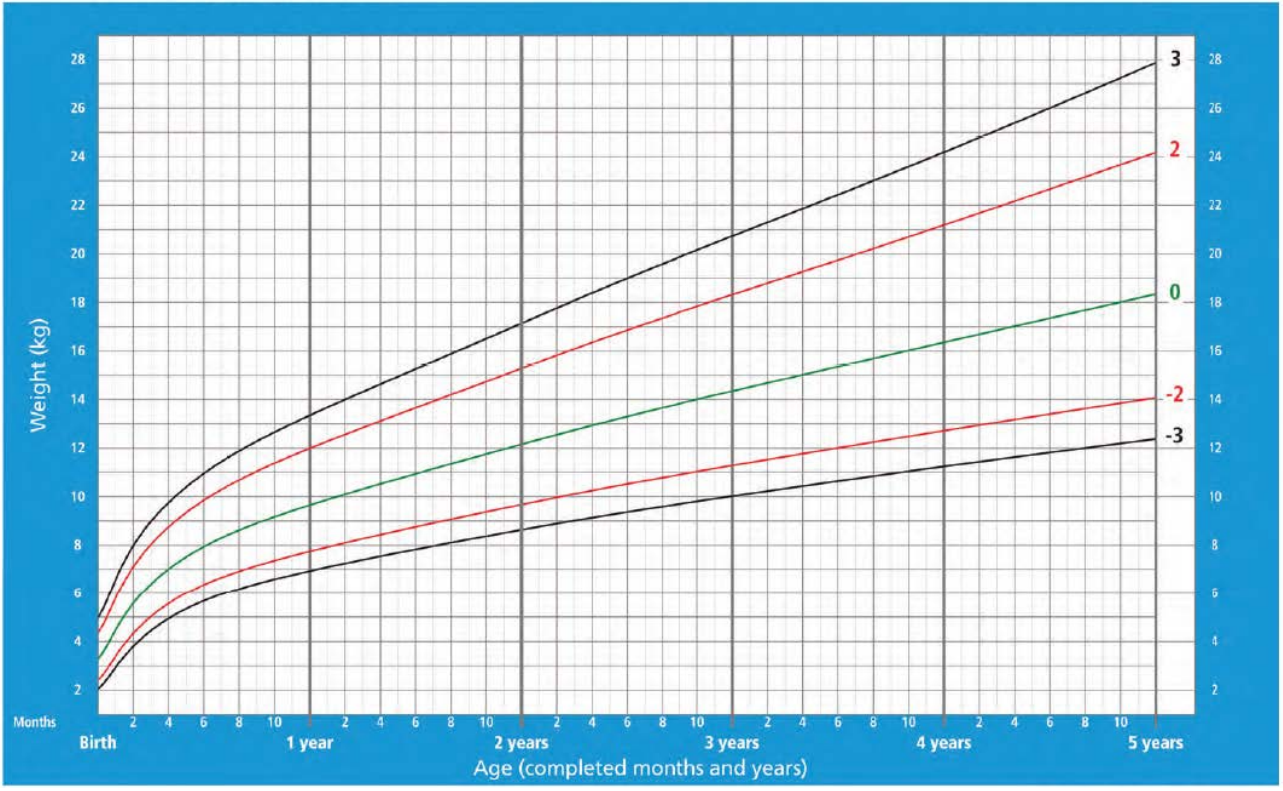
Months	–3 SD	–2 SD	–1 SD	Median	1 SD	2 SD	3 SD
7	5.3	6.0	6.8	7.6	8.6	9.8	11.1
8	5.6	6.3	7.0	7.9	9.0	10.2	11.6
9	5.8	6.5	7.3	8.2	9.3	10.5	12.0
10	5.9	6.7	7.5	8.5	9.6	10.9	12.4
11	6.1	6.9	7.7	8.7	9.9	11.2	12.8
12	6.3	7.0	7.9	8.9	10.1	11.5	13.1
13	6.4	7.2	8.1	9.2	10.4	11.8	13.5
14	6.6	7.4	8.3	9.4	10.6	12.1	13.8
15	6.7	7.6	8.5	9.6	10.9	12.4	14.1
16	6.9	7.7	8.7	9.8	11.1	12.6	14.5
17	7.0	7.9	8.9	10.0	11.4	12.9	14.8
18	7.2	8.1	9.1	10.2	11.6	13.2	15.1
19	7.3	8.2	9.2	10.4	11.8	13.5	15.4
20	7.5	8.4	9.4	10.6	12.1	13.7	15.7
21	7.6	8.6	9.6	10.9	12.3	14.0	16.0
22	7.8	8.7	9.8	11.1	12.5	14.3	16.4
23	7.9	8.9	10.0	11.3	12.8	14.6	16.7
24	8.1	9.0	10.2	11.5	13.0	14.8	17.0
25	8.2	9.2	10.3	11.7	13.3	15.1	17.3
26	8.4	9.4	10.5	11.9	13.5	15.4	17.7
27	8.5	9.5	10.7	12.1	13.7	15.7	18.0
28	8.6	9.7	10.9	12.3	14.0	16.0	18.3
29	8.8	9.8	11.1	12.5	14.2	16.2	18.7
30	8.9	10.0	11.2	12.7	14.4	16.5	19.0
31	9.0	10.1	11.4	12.9	14.7	16.8	19.3
32	9.1	10.3	11.6	13.1	14.9	17.1	19.6
33	9.3	10.4	11.7	13.3	15.1	17.3	20.0
34	9.4	10.5	11.9	13.5	15.4	17.6	20.3
35	9.5	10.7	12.0	13.7	15.6	17.9	20.6
36	9.6	10.8	12.2	13.9	15.8	18.1	20.9
37	9.7	10.9	12.4	14.0	16.0	18.4	21.3

Months	−3 SD	−2 SD	−1 SD	Median	1 SD	2 SD	3 SD
38	9.8	11.1	12.5	14.2	16.3	18.7	21.6
39	9.9	11.2	12.7	14.4	16.5	19.0	22.0
40	10.1	11.3	12.8	14.6	16.7	19.2	22.3
41	10.2	11.5	13.0	14.8	16.9	19.5	22.7
42	10.3	11.6	13.1	15.0	17.2	19.8	23.0
43	10.4	11.7	13.3	15.2	17.4	20.1	23.4
44	10.5	11.8	13.4	15.3	17.6	20.4	23.7
45	10.6	12.0	13.6	15.5	17.8	20.7	24.1
46	10.7	12.1	13.7	15.7	18.1	20.9	24.5
47	10.8	12.2	13.9	15.9	18.3	21.2	24.8
48	10.9	12.3	14.0	16.1	18.5	21.5	25.2
49	11.0	12.4	14.2	16.3	18.8	21.8	25.5
50	11.1	12.6	14.3	16.4	19.0	22.1	25.9
51	11.2	12.7	14.5	16.6	19.2	22.4	26.3
52	11.3	12.8	14.6	16.8	19.4	22.6	26.6
53	11.4	12.9	14.8	17.0	19.7	22.9	27.0
54	11.5	13.0	14.9	17.2	19.9	23.2	27.4
55	11.6	13.2	15.1	17.3	20.1	23.5	27.7
56	11.7	13.3	15.2	17.5	20.3	23.8	28.1
57	11.8	13.4	15.3	17.7	20.6	24.1	28.5
58	11.9	13.5	15.5	17.9	20.8	24.4	28.8
59	12.0	13.6	15.6	18.0	21.0	24.6	29.2
60	12.1	13.7	15.8	18.2	21.2	24.9	29.5

Weight-for-age BOYS

Birth to 5 years (z-scores)

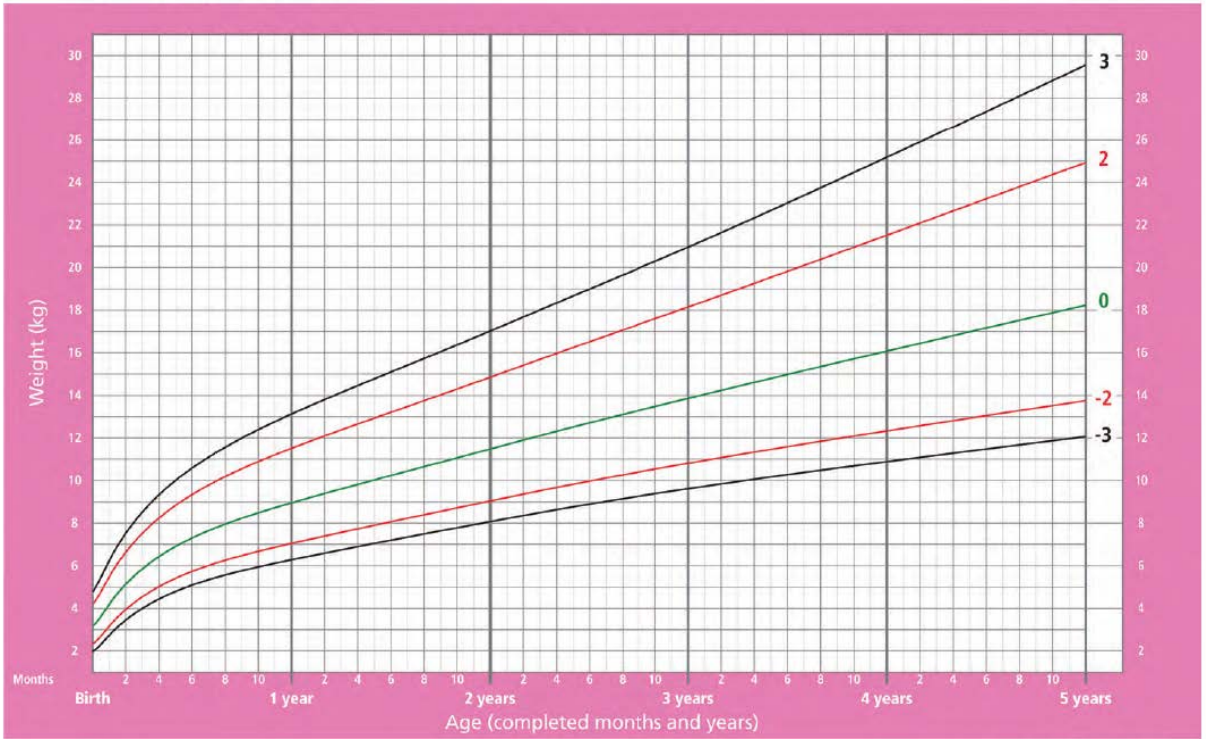
World Health Organization



Weight-for-age GIRLS

Birth to 5 years (z-scores)

World Health Organization



A5.2 Calculating a child's weight-for-length or -height

Tables A5.2.1 and A5.2.2 on pp. 386, 391 give the WHO normalized reference weight-for-length (45–110 cm) and A5.2.3 and A5.2.4 on pp. 395–9 weight-for-height (65–120 cm), by sex.

The interpretation of a fixed percentage of the median value varies by age and height, and generally the two scales cannot be compared. The approximate percentage of the median values for –1 and –2 SD are 90% and 80% of the median, respectively.[1]

'Length' in most cases is measured for a child < 85 cm, and 'height' for a child ≥ 85 cm. Recumbent length is on average 0.5 cm greater than standing height, although the difference is of no importance for the individual child. A correction may be made by deducting 0.5 cm from all lengths > 84.9 cm if standing height cannot be measured.

In the tables:

- Locate the appropriate table for boys or girls.
- Locate the row containing the child's length in the left column.
- Note where the child's weight lies with respect to the lengths recorded in this row.
- Look up the column to read the weight-for-length of the child.

Example 1: Boy: length 61 cm, weight 5.3 kg. His weight-for-length is –2 SD.

Example 2: Girl: length 67 cm, weight 4.3 kg. Her weight-for-length is < –3SD.

Table A5.2.1 Weight-for-length from birth to 2 years: Boys

Length (cm)	–3 SD	–2 SD	–1 SD	Median	1 SD	2 SD	3 SD
45.0	1.9	2.0	2.2	2.4	2.7	3.0	3.3
45.5	1.9	2.1	2.3	2.5	2.8	3.1	3.4
46.0	2.0	2.2	2.4	2.6	2.9	3.1	3.5
46.5	2.1	2.3	2.5	2.7	3.0	3.2	3.6
47.0	2.1	2.3	2.5	2.8	3.0	3.3	3.7
47.5	2.2	2.4	2.6	2.9	3.1	3.4	3.8
48.0	2.3	2.5	2.7	2.9	3.2	3.6	3.9
48.5	2.3	2.6	2.8	3.0	3.3	3.7	4.0

[1] Gorstein J et al. Issues in the assessment of nutritional status using anthropometry. *Bulletin of the World Health Organization*, 1994, 72:273–283.

Length (cm)	–3 SD	–2 SD	–1 SD	Median	1 SD	2 SD	3 SD
49.0	2.4	2.6	2.9	3.1	3.4	3.8	4.2
49.5	2.5	2.7	3.0	3.2	3.5	3.9	4.3
50.0	2.6	2.8	3.0	3.3	3.6	4.0	4.4
50.5	2.7	2.9	3.1	3.4	3.8	4.1	4.5
51.0	2.7	3.0	3.2	3.5	3.9	4.2	4.7
51.5	2.8	3.1	3.3	3.6	4.0	4.4	4.8
52.0	2.9	3.2	3.5	3.8	4.1	4.5	5.0
52.5	3.0	3.3	3.6	3.9	4.2	4.6	5.1
53.0	3.1	3.4	3.7	4.0	4.4	4.8	5.3
53.5	3.2	3.5	3.8	4.1	4.5	4.9	5.4
54.0	3.3	3.6	3.9	4.3	4.7	5.1	5.6
54.5	3.4	3.7	4.0	4.4	4.8	5.3	5.8
55.0	3.6	3.8	4.2	4.5	5.0	5.4	6.0
55.5	3.7	4.0	4.3	4.7	5.1	5.6	6.1
56.0	3.8	4.1	4.4	4.8	5.3	5.8	6.3
56.5	3.9	4.2	4.6	5.0	5.4	5.9	6.5
57.0	4.0	4.3	4.7	5.1	5.6	6.1	6.7
57.5	4.1	4.5	4.9	5.3	5.7	6.3	6.9
58.0	4.3	4.6	5.0	5.4	5.9	6.4	7.1
58.5	4.4	4.7	5.1	5.6	6.1	6.6	7.2
59.0	4.5	4.8	5.3	5.7	6.2	6.8	7.4
59.5	4.6	5.0	5.4	5.9	6.4	7.0	7.6
60.0	4.7	5.1	5.5	6.0	6.5	7.1	7.8
60.5	4.8	5.2	5.6	6.1	6.7	7.3	8.0
61.0	4.9	5.3	5.8	6.3	6.8	7.4	8.1
61.5	5.0	5.4	5.9	6.4	7.0	7.6	8.3
62.0	5.1	5.6	6.0	6.5	7.1	7.7	8.5
62.5	5.2	5.7	6.1	6.7	7.2	7.9	8.6
63.0	5.3	5.8	6.2	6.8	7.4	8.0	8.8
63.5	5.4	5.9	6.4	6.9	7.5	8.2	8.9
64.0	5.5	6.0	6.5	7.0	7.6	8.3	9.1

Length (cm)	–3 SD	–2 SD	–1 SD	Median	1 SD	2 SD	3 SD
64.5	5.6	6.1	6.6	7.1	7.8	8.5	9.3
65.0	5.7	6.2	6.7	7.3	7.9	8.6	9.4
65.5	5.8	6.3	6.8	7.4	8.0	8.7	9.6
66.0	5.9	6.4	6.9	7.5	8.2	8.9	9.7
66.5	6.0	6.5	7.0	7.6	8.3	9.0	9.9
67.0	6.1	6.6	7.1	7.7	8.4	9.2	10.0
67.5	6.2	6.7	7.2	7.9	8.5	9.3	10.2
68.0	6.3	6.8	7.3	8.0	8.7	9.4	10.3
68.5	6.4	6.9	7.5	8.1	8.8	9.6	10.5
69.0	6.5	7.0	7.6	8.2	8.9	9.7	10.6
69.5	6.6	7.1	7.7	8.3	9.0	9.8	10.8
70.0	6.6	7.2	7.8	8.4	9.2	10.0	10.9
70.5	6.7	7.3	7.9	8.5	9.3	10.1	11.1
71.0	6.8	7.4	8.0	8.6	9.4	10.2	11.2
71.5	6.9	7.5	8.1	8.8	9.5	10.4	11.3
72.0	7.0	7.6	8.2	8.9	9.6	10.5	11.5
72.5	7.1	7.6	8.3	9.0	9.8	10.6	11.6
73.0	7.2	7.7	8.4	9.1	9.9	10.8	11.8
73.5	7.2	7.8	8.5	9.2	10.0	10.9	11.9
74.0	7.3	7.9	8.6	9.3	10.1	11.0	12.1
74.5	7.4	8.0	8.7	9.4	10.2	11.2	12.2
75.0	7.5	8.1	8.8	9.5	10.3	11.3	12.3
75.5	7.6	8.2	8.8	9.6	10.4	11.4	12.5
76.0	7.6	8.3	8.9	9.7	10.6	11.5	12.6
76.5	7.7	8.3	9.0	9.8	10.7	11.6	12.7
77.0	7.8	8.4	9.1	9.9	10.8	11.7	12.8
77.5	7.9	8.5	9.2	10.0	10.9	11.9	13.0
78.0	7.9	8.6	9.3	10.1	11.0	12.0	13.1
78.5	8.0	8.7	9.4	10.2	11.1	12.1	13.2
79.0	8.1	8.7	9.5	10.3	11.2	12.2	13.3
79.5	8.2	8.8	9.5	10.4	11.3	12.3	13.4

Length (cm)	−3 SD	−2 SD	−1 SD	Median	1 SD	2 SD	3 SD
80.0	8.2	8.9	9.6	10.4	11.4	12.4	13.6
80.5	8.3	9.0	9.7	10.5	11.5	12.5	13.7
81.0	8.4	9.1	9.8	10.6	11.6	12.6	13.8
81.5	8.5	9.1	9.9	10.7	11.7	12.7	13.9
82.0	8.5	9.2	10.0	10.8	11.8	12.8	14.0
82.5	8.6	9.3	10.1	10.9	11.9	13.0	14.2
83.0	8.7	9.4	10.2	11.0	12.0	13.1	14.3
83.5	8.8	9.5	10.3	11.2	12.1	13.2	14.4
84.0	8.9	9.6	10.4	11.3	12.2	13.3	14.6
84.5	9.0	9.7	10.5	11.4	12.4	13.5	14.7
85.0	9.1	9.8	10.6	11.5	12.5	13.6	14.9
85.5	9.2	9.9	10.7	11.6	12.6	13.7	15.0
86.0	9.3	10.0	10.8	11.7	12.8	13.9	15.2
86.5	9.4	10.1	11.0	11.9	12.9	14.0	15.3
87.0	9.5	10.2	11.1	12.0	13.0	14.2	15.5
87.5	9.6	10.4	11.2	12.1	13.2	14.3	15.6
88.0	9.7	10.5	11.3	12.2	13.3	14.5	15.8
88.5	9.8	10.6	11.4	12.4	13.4	14.6	15.9
89.0	9.9	10.7	11.5	12.5	13.5	14.7	16.1
89.5	10.0	10.8	11.6	12.6	13.7	14.9	16.2
90.0	10.1	10.9	11.8	12.7	13.8	15.0	16.4
90.5	10.2	11.0	11.9	12.8	13.9	15.1	16.5
91.0	10.3	11.1	12.0	13.0	14.1	15.3	16.7
91.5	10.4	11.2	12.1	13.1	14.2	15.4	16.8
92.0	10.5	11.3	12.2	13.2	14.3	15.6	17.0
92.5	10.6	11.4	12.3	13.3	14.4	15.7	17.1
93.0	10.7	11.5	12.4	13.4	14.6	15.8	17.3
93.5	10.7	11.6	12.5	13.5	14.7	16.0	17.4
94.0	10.8	11.7	12.6	13.7	14.8	16.1	17.6
94.5	10.9	11.8	12.7	13.8	14.9	16.3	17.7
95.0	11.0	11.9	12.8	13.9	15.1	16.4	17.9

Length (cm)	–3 SD	–2 SD	–1 SD	Median	1 SD	2 SD	3 SD
95.5	11.1	12.0	12.9	14.0	15.2	16.5	18.0
96.0	11.2	12.1	13.1	14.1	15.3	16.7	18.2
96.5	11.3	12.2	13.2	14.3	15.5	16.8	18.4
97.0	11.4	12.3	13.3	14.4	15.6	17.0	18.5
97.5	11.5	12.4	13.4	14.5	15.7	17.1	18.7
98.0	11.6	12.5	13.5	14.6	15.9	17.3	18.9
98.5	11.7	12.6	13.6	14.8	16.0	17.5	19.1
99.0	11.8	12.7	13.7	14.9	16.2	17.6	19.2
99.5	11.9	12.8	13.9	15.0	16.3	17.8	19.4
100.0	12.0	12.9	14.0	15.2	16.5	18.0	19.6
100.5	12.1	13.0	14.1	15.3	16.6	18.1	19.8
101.0	12.2	13.2	14.2	15.4	16.8	18.3	20.0
101.5	12.3	13.3	14.4	15.6	16.9	18.5	20.2
102.0	12.4	13.4	14.5	15.7	17.1	18.7	20.4
102.5	12.5	13.5	14.6	15.9	17.3	18.8	20.6
103.0	12.6	13.6	14.8	16.0	17.4	19.0	20.8
103.5	12.7	13.7	14.9	16.2	17.6	19.2	21.0
104.0	12.8	13.9	15.0	16.3	17.8	19.4	21.2
104.5	12.9	14.0	15.2	16.5	17.9	19.6	21.5
105.0	13.0	14.1	15.3	16.6	18.1	19.8	21.7
105.5	13.2	14.2	15.4	16.8	18.3	20.0	21.9
106.0	13.3	14.4	15.6	16.9	18.5	20.2	22.1
106.5	13.4	14.5	15.7	17.1	18.6	20.4	22.4
107.0	13.5	14.6	15.9	17.3	18.8	20.6	22.6
107.5	13.6	14.7	16.0	17.4	19.0	20.8	22.8
108.0	13.7	14.9	16.2	17.6	19.2	21.0	23.1
108.5	13.8	15.0	16.3	17.8	19.4	21.2	23.3
109.0	14.0	15.1	16.5	17.9	19.6	21.4	23.6
109.5	14.1	15.3	16.6	18.1	19.8	21.7	23.8
110.0	14.2	15.4	16.8	18.3	20.0	21.9	24.1

Table A5.2.2 Weight-for-length from birth to 2 years: Girls

Length (cm)	–3 SD	–2 SD	–1 SD	Median	1 SD	2 SD	3 SD
45.0	1.9	2.1	2.3	2.5	2.7	3.0	3.3
45.5	2.0	2.1	2.3	2.5	2.8	3.1	3.4
46.0	2.0	2.2	2.4	2.6	2.9	3.2	3.5
46.5	2.1	2.3	2.5	2.7	3.0	3.3	3.6
47.0	2.2	2.4	2.6	2.8	3.1	3.4	3.7
47.5	2.2	2.4	2.6	2.9	3.2	3.5	3.8
48.0	2.3	2.5	2.7	3.0	3.3	3.6	4.0
48.5	2.4	2.6	2.8	3.1	3.4	3.7	4.1
49.0	2.4	2.6	2.9	3.2	3.5	3.8	4.2
49.5	2.5	2.7	3.0	3.3	3.6	3.9	4.3
50.0	2.6	2.8	3.1	3.4	3.7	4.0	4.5
50.5	2.7	2.9	3.2	3.5	3.8	4.2	4.6
51.0	2.8	3.0	3.3	3.6	3.9	4.3	4.8
51.5	2.8	3.1	3.4	3.7	4.0	4.4	4.9
52.0	2.9	3.2	3.5	3.8	4.2	4.6	5.1
52.5	3.0	3.3	3.6	3.9	4.3	4.7	5.2
53.0	3.1	3.4	3.7	4.0	4.4	4.9	5.4
53.5	3.2	3.5	3.8	4.2	4.6	5.0	5.5
54.0	3.3	3.6	3.9	4.3	4.7	5.2	5.7
54.5	3.4	3.7	4.0	4.4	4.8	5.3	5.9
55.0	3.5	3.8	4.2	4.5	5.0	5.5	6.1
55.5	3.6	3.9	4.3	4.7	5.1	5.7	6.3
56.0	3.7	4.0	4.4	4.8	5.3	5.8	6.4
56.5	3.8	4.1	4.5	5.0	5.4	6.0	6.6
57.0	3.9	4.3	4.6	5.1	5.6	6.1	6.8
57.5	4.0	4.4	4.8	5.2	5.7	6.3	7.0
58.0	4.1	4.5	4.9	5.4	5.9	6.5	7.1
58.5	4.2	4.6	5.0	5.5	6.0	6.6	7.3
59.0	4.3	4.7	5.1	5.6	6.2	6.8	7.5
59.5	4.4	4.8	5.3	5.7	6.3	6.9	7.7

Length (cm)	–3 SD	–2 SD	–1 SD	Median	1 SD	2 SD	3 SD
60.0	4.5	4.9	5.4	5.9	6.4	7.1	7.8
60.5	4.6	5.0	5.5	6.0	6.6	7.3	8.0
61.0	4.7	5.1	5.6	6.1	6.7	7.4	8.2
61.5	4.8	5.2	5.7	6.3	6.9	7.6	8.4
62.0	4.9	5.3	5.8	6.4	7.0	7.7	8.5
62.5	5.0	5.4	5.9	6.5	7.1	7.8	8.7
63.0	5.1	5.5	6.0	6.6	7.3	8.0	8.8
63.5	5.2	5.6	6.2	6.7	7.4	8.1	9.0
64.0	5.3	5.7	6.3	6.9	7.5	8.3	9.1
64.5	5.4	5.8	6.4	7.0	7.6	8.4	9.3
65.0	5.5	5.9	6.5	7.1	7.8	8.6	9.5
65.5	5.5	6.0	6.6	7.2	7.9	8.7	9.6
66.0	5.6	6.1	6.7	7.3	8.0	8.8	9.8
66.5	5.7	6.2	6.8	7.4	8.1	9.0	9.9
67.0	5.8	6.3	6.9	7.5	8.3	9.1	10.0
67.5	5.9	6.4	7.0	7.6	8.4	9.2	10.2
68.0	6.0	6.5	7.1	7.7	8.5	9.4	10.3
68.5	6.1	6.6	7.2	7.9	8.6	9.5	10.5
69.0	6.1	6.7	7.3	8.0	8.7	9.6	10.6
69.5	6.2	6.8	7.4	8.1	8.8	9.7	10.7
70.0	6.3	6.9	7.5	8.2	9.0	9.9	10.9
70.5	6.4	6.9	7.6	8.3	9.1	10.0	11.0
71.0	6.5	7.0	7.7	8.4	9.2	10.1	11.1
71.5	6.5	7.1	7.7	8.5	9.3	10.2	11.3
72.0	6.6	7.2	7.8	8.6	9.4	10.3	11.4
72.5	6.7	7.3	7.9	8.7	9.5	10.5	11.5
73.0	6.8	7.4	8.0	8.8	9.6	10.6	11.7
73.5	6.9	7.4	8.1	8.9	9.7	10.7	11.8
74.0	6.9	7.5	8.2	9.0	9.8	10.8	11.9
74.5	7.0	7.6	8.3	9.1	9.9	10.9	12.0
75.0	7.1	7.7	8.4	9.1	10.0	11.0	12.2

Length (cm)	–3 SD	–2 SD	–1 SD	Median	1 SD	2 SD	3 SD
75.5	7.1	7.8	8.5	9.2	10.1	11.1	12.3
76.0	7.2	7.8	8.5	9.3	10.2	11.2	12.4
76.5	7.3	7.9	8.6	9.4	10.3	11.4	12.5
77.0	7.4	8.0	8.7	9.5	10.4	11.5	12.6
77.5	7.4	8.1	8.8	9.6	10.5	11.6	12.8
78.0	7.5	8.2	8.9	9.7	10.6	11.7	12.9
78.5	7.6	8.2	9.0	9.8	10.7	11.8	13.0
79.0	7.7	8.3	9.1	9.9	10.8	11.9	13.1
79.5	7.7	8.4	9.1	10.0	10.9	12.0	13.3
80.0	7.8	8.5	9.2	10.1	11.0	12.1	13.4
80.5	7.9	8.6	9.3	10.2	11.2	12.3	13.5
81.0	8.0	8.7	9.4	10.3	11.3	12.4	13.7
81.5	8.1	8.8	9.5	10.4	11.4	12.5	13.8
82.0	8.1	8.8	9.6	10.5	11.5	12.6	13.9
82.5	8.2	8.9	9.7	10.6	11.6	12.8	14.1
83.0	8.3	9.0	9.8	10.7	11.8	12.9	14.2
83.5	8.4	9.1	9.9	10.9	11.9	13.1	14.4
84.0	8.5	9.2	10.1	11.0	12.0	13.2	14.5
84.5	8.6	9.3	10.2	11.1	12.1	13.3	14.7
85.0	8.7	9.4	10.3	11.2	12.3	13.5	14.9
85.5	8.8	9.5	10.4	11.3	12.4	13.6	15.0
86.0	8.9	9.7	10.5	11.5	12.6	13.8	15.2
86.5	9.0	9.8	10.6	11.6	12.7	13.9	15.4
87.0	9.1	9.9	10.7	11.7	12.8	14.1	15.5
87.5	9.2	10.0	10.9	11.8	13.0	14.2	15.7
88.0	9.3	10.1	11.0	12.0	13.1	14.4	15.9
88.5	9.4	10.2	11.1	12.1	13.2	14.5	16.0
89.0	9.5	10.3	11.2	12.2	13.4	14.7	16.2
89.5	9.6	10.4	11.3	12.3	13.5	14.8	16.4
90.0	9.7	10.5	11.4	12.5	13.7	15.0	16.5
90.5	9.8	10.6	11.5	12.6	13.8	15.1	16.7

Length (cm)	−3 SD	−2 SD	−1 SD	Median	1 SD	2 SD	3 SD
91.0	9.9	10.7	11.7	12.7	13.9	15.3	16.9
91.5	10.0	10.8	11.8	12.8	14.1	15.5	17.0
92.0	10.1	10.9	11.9	13.0	14.2	15.6	17.2
92.5	10.1	11.0	12.0	13.1	14.3	15.8	17.4
93.0	10.2	11.1	12.1	13.2	14.5	15.9	17.5
93.5	10.3	11.2	12.2	13.3	14.6	16.1	17.7
94.0	10.4	11.3	12.3	13.5	14.7	16.2	17.9
94.5	10.5	11.4	12.4	13.6	14.9	16.4	18.0
95.0	10.6	11.5	12.6	13.7	15.0	16.5	18.2
95.5	10.7	11.6	12.7	13.8	15.2	16.7	18.4
96.0	10.8	11.7	12.8	14.0	15.3	16.8	18.6
96.5	10.9	11.8	12.9	14.1	15.4	17.0	18.7
97.0	11.0	12.0	13.0	14.2	15.6	17.1	18.9
97.5	11.1	12.1	13.1	14.4	15.7	17.3	19.1
98.0	11.2	12.2	13.3	14.5	15.9	17.5	19.3
98.5	11.3	12.3	13.4	14.6	16.0	17.6	19.5
99.0	11.4	12.4	13.5	14.8	16.2	17.8	19.6
99.5	11.5	12.5	13.6	14.9	16.3	18.0	19.8
100.0	11.6	12.6	13.7	15.0	16.5	18.1	20.0
100.5	11.7	12.7	13.9	15.2	16.6	18.3	20.2
101.0	11.8	12.8	14.0	15.3	16.8	18.5	20.4
101.5	11.9	13.0	14.1	15.5	17.0	18.7	20.6
102.0	12.0	13.1	14.3	15.6	17.1	18.9	20.8
102.5	12.1	13.2	14.4	15.8	17.3	19.0	21.0
103.0	12.3	13.3	14.5	15.9	17.5	19.2	21.3
103.5	12.4	13.5	14.7	16.1	17.6	19.4	21.5
104.0	12.5	13.6	14.8	16.2	17.8	19.6	21.7
104.5	12.6	13.7	15.0	16.4	18.0	19.8	21.9
105.0	12.7	13.8	15.1	16.5	18.2	20.0	22.2
105.5	12.8	14.0	15.3	16.7	18.4	20.2	22.4
106.0	13.0	14.1	15.4	16.9	18.5	20.5	22.6

Length (cm)	–3 SD	–2 SD	–1 SD	Median	1 SD	2 SD	3 SD
106.5	13.1	14.3	15.6	17.1	18.7	20.7	22.9
107.0	13.2	14.4	15.7	17.2	18.9	20.9	23.1
107.5	13.3	14.5	15.9	17.4	19.1	21.1	23.4
108.0	13.5	14.7	16.0	17.6	19.3	21.3	23.6
108.5	13.6	14.8	16.2	17.8	19.5	21.6	23.9
109.0	13.7	15.0	16.4	18.0	19.7	21.8	24.2
109.5	13.9	15.1	16.5	18.1	20.0	22.0	24.4
110.0	14.0	15.3	16.7	18.3	20.2	22.3	24.7

Table A5.2.3 Weight-for-height from 2 to 5 years: Boys

Height (cm)	–3 SD	–2 SD	–1 SD	Median	1 SD	2 SD	3 SD
65.0	5.9	6.3	6.9	7.4	8.1	8.8	9.6
65.5	6.0	6.4	7.0	7.6	8.2	8.9	9.8
66.0	6.1	6.5	7.1	7.7	8.3	9.1	9.9
66.5	6.1	6.6	7.2	7.8	8.5	9.2	10.1
67.0	6.2	6.7	7.3	7.9	8.6	9.4	10.2
67.5	6.3	6.8	7.4	8.0	8.7	9.5	10.4
68.0	6.4	6.9	7.5	8.1	8.8	9.6	10.5
68.5	6.5	7.0	7.6	8.2	9.0	9.8	10.7
69.0	6.6	7.1	7.7	8.4	9.1	9.9	10.8
69.5	6.7	7.2	7.8	8.5	9.2	10.0	11.0
70.0	6.8	7.3	7.9	8.6	9.3	10.2	11.1
70.5	6.9	7.4	8.0	8.7	9.5	10.3	11.3
71.0	6.9	7.5	8.1	8.8	9.6	10.4	11.4
71.5	7.0	7.6	8.2	8.9	9.7	10.6	11.6
72.0	7.1	7.7	8.3	9.0	9.8	10.7	11.7
72.5	7.2	7.8	8.4	9.1	9.9	10.8	11.8
73.0	7.3	7.9	8.5	9.2	10.0	11.0	12.0
73.5	7.4	7.9	8.6	9.3	10.2	11.1	12.1
74.0	7.4	8.0	8.7	9.4	10.3	11.2	12.2
74.5	7.5	8.1	8.8	9.5	10.4	11.3	12.4

Height (cm)	−3 SD	−2 SD	−1 SD	Median	1 SD	2 SD	3 SD
75.0	7.6	8.2	8.9	9.6	10.5	11.4	12.5
75.5	7.7	8.3	9.0	9.7	10.6	11.6	12.6
76.0	7.7	8.4	9.1	9.8	10.7	11.7	12.8
76.5	7.8	8.5	9.2	9.9	10.8	11.8	12.9
77.0	7.9	8.5	9.2	10.0	10.9	11.9	13.0
77.5	8.0	8.6	9.3	10.1	11.0	12.0	13.1
78.0	8.0	8.7	9.4	10.2	11.1	12.1	13.3
78.5	8.1	8.8	9.5	10.3	11.2	12.2	13.4
79.0	8.2	8.8	9.6	10.4	11.3	12.3	13.5
79.5	8.3	8.9	9.7	10.5	11.4	12.4	13.6
80.0	8.3	9.0	9.7	10.6	11.5	12.6	13.7
80.5	8.4	9.1	9.8	10.7	11.6	12.7	13.8
81.0	8.5	9.2	9.9	10.8	11.7	12.8	14.0
81.5	8.6	9.3	10.0	10.9	11.8	12.9	14.1
82.0	8.7	9.3	10.1	11.0	11.9	13.0	14.2
82.5	8.7	9.4	10.2	11.1	12.1	13.1	14.4
83.0	8.8	9.5	10.3	11.2	12.2	13.3	14.5
83.5	8.9	9.6	10.4	11.3	12.3	13.4	14.6
84.0	9.0	9.7	10.5	11.4	12.4	13.5	14.8
84.5	9.1	9.9	10.7	11.5	12.5	13.7	14.9
85.0	9.2	10.0	10.8	11.7	12.7	13.8	15.1
85.5	9.3	10.1	10.9	11.8	12.8	13.9	15.2
86.0	9.4	10.2	11.0	11.9	12.9	14.1	15.4
86.5	9.5	10.3	11.1	12.0	13.1	14.2	15.5
87.0	9.6	10.4	11.2	12.2	13.2	14.4	15.7
87.5	9.7	10.5	11.3	12.3	13.3	14.5	15.8
88.0	9.8	10.6	11.5	12.4	13.5	14.7	16.0
88.5	9.9	10.7	11.6	12.5	13.6	14.8	16.1
89.0	10.0	10.8	11.7	12.6	13.7	14.9	16.3
89.5	10.1	10.9	11.8	12.8	13.9	15.1	16.4
90.0	10.2	11.0	11.9	12.9	14.0	15.2	16.6

Height (cm)	−3 SD	−2 SD	−1 SD	Median	1 SD	2 SD	3 SD
90.5	10.3	11.1	12.0	13.0	14.1	15.3	16.7
91.0	10.4	11.2	12.1	13.1	14.2	15.5	16.9
91.5	10.5	11.3	12.2	13.2	14.4	15.6	17.0
92.0	10.6	11.4	12.3	13.4	14.5	15.8	17.2
92.5	10.7	11.5	12.4	13.5	14.6	15.9	17.3
93.0	10.8	11.6	12.6	13.6	14.7	16.0	17.5
93.5	10.9	11.7	12.7	13.7	14.9	16.2	17.6
94.0	11.0	11.8	12.8	13.8	15.0	16.3	17.8
94.5	11.1	11.9	12.9	13.9	15.1	16.5	17.9
95.0	11.1	12.0	13.0	14.1	15.3	16.6	18.1
95.5	11.2	12.1	13.1	14.2	15.4	16.7	18.3
96.0	11.3	12.2	13.2	14.3	15.5	16.9	18.4
96.5	11.4	12.3	13.3	14.4	15.7	17.0	18.6
97.0	11.5	12.4	13.4	14.6	15.8	17.2	18.8
97.5	11.6	12.5	13.6	14.7	15.9	17.4	18.9
98.0	11.7	12.6	13.7	14.8	16.1	17.5	19.1
98.5	11.8	12.8	13.8	14.9	16.2	17.7	19.3
99.0	11.9	12.9	13.9	15.1	16.4	17.9	19.5
99.5	12.0	13.0	14.0	15.2	16.5	18.0	19.7
100.0	12.1	13.1	14.2	15.4	16.7	18.2	19.9
100.5	12.2	13.2	14.3	15.5	16.9	18.4	20.1
101.0	12.3	13.3	14.4	15.6	17.0	18.5	20.3
101.5	12.4	13.4	14.5	15.8	17.2	18.7	20.5
102.0	12.5	13.6	14.7	15.9	17.3	18.9	20.7
102.5	12.6	13.7	14.8	16.1	17.5	19.1	20.9
103.0	12.8	13.8	14.9	16.2	17.7	19.3	21.1
103.5	12.9	13.9	15.1	16.4	17.8	19.5	21.3
104.0	13.0	14.0	15.2	16.5	18.0	19.7	21.6
104.5	13.1	14.2	15.4	16.7	18.2	19.9	21.8
105.0	13.2	14.3	15.5	16.8	18.4	20.1	22.0
105.5	13.3	14.4	15.6	17.0	18.5	20.3	22.2

Height (cm)	–3 SD	–2 SD	–1 SD	Median	1 SD	2 SD	3 SD
106.0	13.4	14.5	15.8	17.2	18.7	20.5	22.5
106.5	13.5	14.7	15.9	17.3	18.9	20.7	22.7
107.0	13.7	14.8	16.1	17.5	19.1	20.9	22.9
107.5	13.8	14.9	16.2	17.7	19.3	21.1	23.2
108.0	13.9	15.1	16.4	17.8	19.5	21.3	23.4
108.5	14.0	15.2	16.5	18.0	19.7	21.5	23.7
109.0	14.1	15.3	16.7	18.2	19.8	21.8	23.9
109.5	14.3	15.5	16.8	18.3	20.0	22.0	24.2
110.0	14.4	15.6	17.0	18.5	20.2	22.2	24.4
110.5	14.5	15.8	17.1	18.7	20.4	22.4	24.7
111.0	14.6	15.9	17.3	18.9	20.7	22.7	25.0
111.5	14.8	16.0	17.5	19.1	20.9	22.9	25.2
112.0	14.9	16.2	17.6	19.2	21.1	23.1	25.5
112.5	15.0	16.3	17.8	19.4	21.3	23.4	25.8
113.0	15.2	16.5	18.0	19.6	21.5	23.6	26.0
113.5	15.3	16.6	18.1	19.8	21.7	23.9	26.3
114.0	15.4	16.8	18.3	20.0	21.9	24.1	26.6
114.5	15.6	16.9	18.5	20.2	22.1	24.4	26.9
115.0	15.7	17.1	18.6	20.4	22.4	24.6	27.2
115.5	15.8	17.2	18.8	20.6	22.6	24.9	27.5
116.0	16.0	17.4	19.0	20.8	22.8	25.1	27.8
116.5	16.1	17.5	19.2	21.0	23.0	25.4	28.0
117.0	16.2	17.7	19.3	21.2	23.3	25.6	28.3
117.5	16.4	17.9	19.5	21.4	23.5	25.9	28.6
118.0	16.5	18.0	19.7	21.6	23.7	26.1	28.9
118.5	16.7	18.2	19.9	21.8	23.9	26.4	29.2
119.0	16.8	18.3	20.0	22.0	24.1	26.6	29.5
119.5	16.9	18.5	20.2	22.2	24.4	26.9	29.8
120.0	17.1	18.6	20.4	22.4	24.6	27.2	30.1

Table A5.2.4 Weight-for-height from 2 to 5 years: Girls

Height (cm)	–3 SD	–2 SD	–1 SD	Median	1 SD	2 SD	3 SD
65.0	5.6	6.1	6.6	7.2	7.9	8.7	9.7
65.5	5.7	6.2	6.7	7.4	8.1	8.9	9.8
66.0	5.8	6.3	6.8	7.5	8.2	9.0	10.0
66.5	5.8	6.4	6.9	7.6	8.3	9.1	10.1
67.0	5.9	6.4	7.0	7.7	8.4	9.3	10.2
67.5	6.0	6.5	7.1	7.8	8.5	9.4	10.4
68.0	6.1	6.6	7.2	7.9	8.7	9.5	10.5
68.5	6.2	6.7	7.3	8.0	8.8	9.7	10.7
69.0	6.3	6.8	7.4	8.1	8.9	9.8	10.8
69.5	6.3	6.9	7.5	8.2	9.0	9.9	10.9
70.0	6.4	7.0	7.6	8.3	9.1	10.0	11.1
70.5	6.5	7.1	7.7	8.4	9.2	10.1	11.2
71.0	6.6	7.1	7.8	8.5	9.3	10.3	11.3
71.5	6.7	7.2	7.9	8.6	9.4	10.4	11.5
72.0	6.7	7.3	8.0	8.7	9.5	10.5	11.6
72.5	6.8	7.4	8.1	8.8	9.7	10.6	11.7
73.0	6.9	7.5	8.1	8.9	9.8	10.7	11.8
73.5	7.0	7.6	8.2	9.0	9.9	10.8	12.0
74.0	7.0	7.6	8.3	9.1	10.0	11.0	12.1
74.5	7.1	7.7	8.4	9.2	10.1	11.1	12.2
75.0	7.2	7.8	8.5	9.3	10.2	11.2	12.3
75.5	7.2	7.9	8.6	9.4	10.3	11.3	12.5
76.0	7.3	8.0	8.7	9.5	10.4	11.4	12.6
76.5	7.4	8.0	8.7	9.6	10.5	11.5	12.7
77.0	7.5	8.1	8.8	9.6	10.6	11.6	12.8
77.5	7.5	8.2	8.9	9.7	10.7	11.7	12.9
78.0	7.6	8.3	9.0	9.8	10.8	11.8	13.1
78.5	7.7	8.4	9.1	9.9	10.9	12.0	13.2
79.0	7.8	8.4	9.2	10.0	11.0	12.1	13.3
79.5	7.8	8.5	9.3	10.1	11.1	12.2	13.4

Height (cm)	−3 SD	−2 SD	−1 SD	Median	1 SD	2 SD	3 SD
80.0	7.9	8.6	9.4	10.2	11.2	12.3	13.6
80.5	8.0	8.7	9.5	10.3	11.3	12.4	13.7
81.0	8.1	8.8	9.6	10.4	11.4	12.6	13.9
81.5	8.2	8.9	9.7	10.6	11.6	12.7	14.0
82.0	8.3	9.0	9.8	10.7	11.7	12.8	14.1
82.5	8.4	9.1	9.9	10.8	11.8	13.0	14.3
83.0	8.5	9.2	10.0	10.9	11.9	13.1	14.5
83.5	8.5	9.3	10.1	11.0	12.1	13.3	14.6
84.0	8.6	9.4	10.2	11.1	12.2	13.4	14.8
84.5	8.7	9.5	10.3	11.3	12.3	13.5	14.9
85.0	8.8	9.6	10.4	11.4	12.5	13.7	15.1
85.5	8.9	9.7	10.6	11.5	12.6	13.8	15.3
86.0	9.0	9.8	10.7	11.6	12.7	14.0	15.4
86.5	9.1	9.9	10.8	11.8	12.9	14.2	15.6
87.0	9.2	10.0	10.9	11.9	13.0	14.3	15.8
87.5	9.3	10.1	11.0	12.0	13.2	14.5	15.9
88.0	9.4	10.2	11.1	12.1	13.3	14.6	16.1
88.5	9.5	10.3	11.2	12.3	13.4	14.8	16.3
89.0	9.6	10.4	11.4	12.4	13.6	14.9	16.4
89.5	9.7	10.5	11.5	12.5	13.7	15.1	16.6
90.0	9.8	10.6	11.6	12.6	13.8	15.2	16.8
90.5	9.9	10.7	11.7	12.8	14.0	15.4	16.9
91.0	10.0	10.9	11.8	12.9	14.1	15.5	17.1
91.5	10.1	11.0	11.9	13.0	14.3	15.7	17.3
92.0	10.2	11.1	12.0	13.1	14.4	15.8	17.4
92.5	10.3	11.2	12.1	13.3	14.5	16.0	17.6
93.0	10.4	11.3	12.3	13.4	14.7	16.1	17.8
93.5	10.5	11.4	12.4	13.5	14.8	16.3	17.9
94.0	10.6	11.5	12.5	13.6	14.9	16.4	18.1
94.5	10.7	11.6	12.6	13.8	15.1	16.6	18.3
95.0	10.8	11.7	12.7	13.9	15.2	16.7	18.5

Height (cm)	–3 SD	–2 SD	–1 SD	Median	1 SD	2 SD	3 SD
95.5	10.8	11.8	12.8	14.0	15.4	16.9	18.6
96.0	10.9	11.9	12.9	14.1	15.5	17.0	18.8
96.5	11.0	12.0	13.1	14.3	15.6	17.2	19.0
97.0	11.1	12.1	13.2	14.4	15.8	17.4	19.2
97.5	11.2	12.2	13.3	14.5	15.9	17.5	19.3
98.0	11.3	12.3	13.4	14.7	16.1	17.7	19.5
98.5	11.4	12.4	13.5	14.8	16.2	17.9	19.7
99.0	11.5	12.5	13.7	14.9	16.4	18.0	19.9
99.5	11.6	12.7	13.8	15.1	16.5	18.2	20.1
100.0	11.7	12.8	13.9	15.2	16.7	18.4	20.3
100.5	11.9	12.9	14.1	15.4	16.9	18.6	20.5
101.0	12.0	13.0	14.2	15.5	17.0	18.7	20.7
101.5	12.1	13.1	14.3	15.7	17.2	18.9	20.9
102.0	12.2	13.3	14.5	15.8	17.4	19.1	21.1
102.5	12.3	13.4	14.6	16.0	17.5	19.3	21.4
103.0	12.4	13.5	14.7	16.1	17.7	19.5	21.6
103.5	12.5	13.6	14.9	16.3	17.9	19.7	21.8
104.0	12.6	13.8	15.0	16.4	18.1	19.9	22.0
104.5	12.8	13.9	15.2	16.6	18.2	20.1	22.3
105.0	12.9	14.0	15.3	16.8	18.4	20.3	22.5
105.5	13.0	14.2	15.5	16.9	18.6	20.5	22.7
106.0	13.1	14.3	15.6	17.1	18.8	20.8	23.0
106.5	13.3	14.5	15.8	17.3	19.0	21.0	23.2
107.0	13.4	14.6	15.9	17.5	19.2	21.2	23.5
107.5	13.5	14.7	16.1	17.7	19.4	21.4	23.7
108.0	13.7	14.9	16.3	17.8	19.6	21.7	24.0
108.5	13.8	15.0	16.4	18.0	19.8	21.9	24.3
109.0	13.9	15.2	16.6	18.2	20.0	22.1	24.5
109.5	14.1	15.4	16.8	18.4	20.3	22.4	24.8
110.0	14.2	15.5	17.0	18.6	20.5	22.6	25.1
110.5	14.4	15.7	17.1	18.8	20.7	22.9	25.4

Height (cm)	−3 SD	−2 SD	−1 SD	Median	1 SD	2 SD	3 SD
111.0	14.5	15.8	17.3	19.0	20.9	23.1	25.7
111.5	14.7	16.0	17.5	19.2	21.2	23.4	26.0
112.0	14.8	16.2	17.7	19.4	21.4	23.6	26.2
112.5	15.0	16.3	17.9	19.6	21.6	23.9	26.5
113.0	15.1	16.5	18.0	19.8	21.8	24.2	26.8
113.5	15.3	16.7	18.2	20.0	22.1	24.4	27.1
114.0	15.4	16.8	18.4	20.2	22.3	24.7	27.4
114.5	15.6	17.0	18.6	20.5	22.6	25.0	27.8
115.0	15.7	17.2	18.8	20.7	22.8	25.2	28.1
115.5	15.9	17.3	19.0	20.9	23.0	25.5	28.4
116.0	16.0	17.5	19.2	21.1	23.3	25.8	28.7
116.5	16.2	17.7	19.4	21.3	23.5	26.1	29.0
117.0	16.3	17.8	19.6	21.5	23.8	26.3	29.3
117.5	16.5	18.0	19.8	21.7	24.0	26.6	29.6
118.0	16.6	18.2	19.9	22.0	24.2	26.9	29.9
118.5	16.8	18.4	20.1	22.2	24.5	27.2	30.3
119.0	16.9	18.5	20.3	22.4	24.7	27.4	30.6
119.5	17.1	18.7	20.5	22.6	25.0	27.7	30.9
120.0	17.3	18.9	20.7	22.8	25.2	28.0	31.2

ANNEX 6: BP Levels for Boys and Girls

Blood Pressure Levels for Boys by Age and Height Percentile

Age (Year)	BP Percentile ↓	Systolic BP (mmHg) ← Percentile of Height →							Diastolic BP (mmHg) ← Percentile of Height →						
		5th	10th	25th	50th	75th	90th	95th	5th	10th	25th	50th	75th	90th	95th
1	50th	80	81	83	85	87	88	89	34	35	36	37	38	39	39
	90th	94	95	97	99	100	102	103	49	50	51	52	53	53	54
	95th	98	99	101	103	104	106	106	54	54	55	56	57	58	58
	99th	105	106	108	110	112	113	114	61	62	63	64	65	66	66
2	50th	84	85	87	88	90	92	92	39	40	41	42	43	44	44
	90th	97	99	100	102	104	105	106	54	55	56	57	58	58	59
	95th	101	102	104	106	108	109	110	59	59	60	61	62	63	63
	99th	109	110	111	113	115	117	117	66	67	68	69	70	71	71
3	50th	86	87	89	91	93	94	95	44	44	45	46	47	48	48
	90th	100	101	103	105	107	108	109	59	59	60	61	62	63	63
	95th	104	105	107	109	110	112	113	63	63	64	65	66	67	67
	99th	111	112	114	116	118	119	120	71	71	72	73	74	75	75
4	50th	88	89	91	93	95	96	97	47	48	49	50	51	51	52
	90th	102	103	105	107	109	110	111	62	63	64	65	66	66	67
	95th	106	107	109	111	112	114	115	66	67	68	69	70	71	71
	99th	113	114	116	118	120	121	122	74	75	76	77	78	78	79
5	50th	90	91	93	95	96	98	98	50	51	52	53	54	55	55
	90th	104	105	106	108	110	111	112	65	66	67	68	69	69	70
	95th	108	109	110	112	114	115	116	69	70	71	72	73	74	74
	99th	115	116	118	120	121	123	123	77	78	79	80	81	81	82
6	50th	91	92	94	96	98	99	100	53	53	54	55	56	57	57
	90th	105	106	108	110	111	113	113	68	68	69	70	71	72	72
	95th	109	110	112	114	115	117	117	72	72	73	74	75	76	76
	99th	116	117	119	121	123	124	125	80	80	81	82	83	84	84
7	50th	92	94	95	97	99	100	101	55	55	56	57	58	59	59
	90th	106	107	109	111	113	114	115	70	70	71	72	73	74	74
	95th	110	111	113	115	117	118	119	74	74	75	76	77	78	78
	99th	117	118	120	122	124	125	126	82	82	83	84	85	86	86
8	50th	94	95	97	99	100	102	102	56	57	58	59	60	60	61
	90th	107	109	110	112	114	115	116	71	72	72	73	74	75	76
	95th	111	112	114	116	118	119	120	75	76	77	78	79	79	80
	99th	119	120	122	123	125	127	127	83	84	85	86	87	87	88
9	50th	95	96	98	100	102	103	104	57	58	59	60	61	61	62
	90th	109	110	112	114	115	117	118	72	73	74	75	76	76	77
	95th	113	114	116	118	119	121	121	76	77	78	79	80	81	81
	99th	120	121	123	125	127	128	129	84	85	86	87	88	88	89
10	50th	97	98	100	102	103	105	106	58	59	60	61	61	62	63
	90th	111	112	114	115	117	119	119	73	73	74	75	76	77	78
	95th	115	116	117	119	121	122	123	77	78	79	80	81	81	82
	99th	122	123	125	127	128	130	130	85	86	86	88	88	89	90

Blood Pressure Levels for Boys by Age and Height Percentile (Continued)

Age (Year)	BP Percentile ↓	Systolic BP (mmHg)							Diastolic BP (mmHg)						
		← Percentile of Height →							← Percentile of Height →						
		5th	10th	25th	50th	75th	90th	95th	5th	10th	25th	50th	75th	90th	95th
11	50th	99	100	102	104	105	107	107	59	59	60	61	62	63	63
	90th	113	114	115	117	119	120	121	74	74	75	76	77	78	78
	95th	117	118	119	121	123	124	125	78	78	79	80	81	82	82
	99th	124	125	127	129	130	132	132	86	86	87	88	89	90	90
12	50th	101	102	104	106	108	109	110	59	60	61	62	63	63	64
	90th	115	116	118	120	121	123	123	74	75	75	76	77	78	79
	95th	119	120	122	123	125	127	127	78	79	80	81	82	82	83
	99th	126	127	129	131	133	134	135	86	87	88	89	90	90	91
13	50th	104	105	106	108	110	111	112	60	60	61	62	63	64	64
	90th	117	118	120	122	124	125	126	75	75	76	77	78	79	79
	95th	121	122	124	126	128	129	130	79	79	80	81	82	83	83
	99th	128	130	131	133	135	136	137	87	87	88	89	90	91	91
14	50th	106	107	109	111	113	114	115	60	61	62	63	64	65	65
	90th	120	121	123	125	126	128	128	75	76	77	78	79	79	80
	95th	124	125	127	128	130	132	132	80	80	81	82	83	84	84
	99th	131	132	134	136	138	139	140	87	88	89	90	91	92	92
15	50th	109	110	112	113	115	117	117	61	62	63	64	65	66	66
	90th	122	124	125	127	129	130	131	76	77	78	79	80	80	81
	95th	126	127	129	131	133	134	135	81	81	82	83	84	85	85
	99th	134	135	136	138	140	142	142	88	89	90	91	92	93	93
16	50th	111	112	114	116	118	119	120	63	63	64	65	66	67	67
	90th	125	126	128	130	131	133	134	78	78	79	80	81	82	82
	95th	129	130	132	134	135	137	137	82	83	83	84	85	86	87
	99th	136	137	139	141	143	144	145	90	90	91	92	93	94	94
17	50th	114	115	116	118	120	121	122	65	66	66	67	68	69	70
	90th	127	128	130	132	134	135	136	80	80	81	82	83	84	84
	95th	131	132	134	136	138	139	140	84	85	86	87	87	88	89
	99th	139	140	141	143	145	146	147	92	93	93	94	95	96	97

BP, blood pressure

* The 90th percentile is 1.28 SD, 95th percentile is 1.645 SD, and the 99th percentile is 2.326 SD over the mean.

For research purposes, the standard deviations in Appendix Table B–1 allow one to compute BP Z-scores and percentiles for boys with height percentiles given in Table 3 (i.e., the 5th,10th, 25th, 50th, 75th, 90th, and 95th percentiles). These height percentiles must be converted to height Z-scores given by (5% = -1.645; 10% = -1.28; 25% = -0.68; 50% = 0; 75% = 0.68; 90% = 1.28%; 95% = 1.645) and then computed according to the methodology in steps 2–4 described in Appendix B. For children with height percentiles other than these, follow steps 1–4 as described in Appendix B.

Blood Pressure Levels for Girls by Age and Height Percentile

Age (Year)	BP Percentile ↓	Systolic BP (mmHg) ← Percentile of Height →							Diastolic BP (mmHg) ← Percentile of Height →						
		5th	10th	25th	50th	75th	90th	95th	5th	10th	25th	50th	75th	90th	95th
1	50th	83	84	85	86	88	89	90	38	39	39	40	41	41	42
	90th	97	97	98	100	101	102	103	52	53	53	54	55	55	56
	95th	100	101	102	104	105	106	107	56	57	57	58	59	59	60
	99th	108	108	109	111	112	113	114	64	64	65	65	66	67	67
2	50th	85	85	87	88	89	91	91	43	44	44	45	46	46	47
	90th	98	99	100	101	103	104	105	57	58	58	59	60	61	61
	95th	102	103	104	105	107	108	109	61	62	62	63	64	65	65
	99th	109	110	111	112	114	115	116	69	69	70	70	71	72	72
3	50th	86	87	88	89	91	92	93	47	48	48	49	50	50	51
	90th	100	100	102	103	104	106	106	61	62	62	63	64	64	65
	95th	104	104	105	107	108	109	110	65	66	66	67	68	68	69
	99th	111	111	113	114	115	116	117	73	73	74	74	75	76	76
4	50th	88	88	90	91	92	94	94	50	50	51	52	52	53	54
	90th	101	102	103	104	106	107	108	64	64	65	66	67	67	68
	95th	105	106	107	108	110	111	112	68	68	69	70	71	71	72
	99th	112	113	114	115	117	118	119	76	76	76	77	78	79	79
5	50th	89	90	91	93	94	95	96	52	53	53	54	55	55	56
	90th	103	103	105	106	107	109	109	66	67	67	68	69	69	70
	95th	107	107	108	110	111	112	113	70	71	71	72	73	73	74
	99th	114	114	116	117	118	120	120	78	78	79	79	80	81	81
6	50th	91	92	93	94	96	97	98	54	54	55	56	56	57	58
	90th	104	105	106	108	109	110	111	68	68	69	70	70	71	72
	95th	108	109	110	111	113	114	115	72	72	73	74	74	75	76
	99th	115	116	117	119	120	121	122	80	80	80	81	82	83	83
7	50th	93	93	95	96	97	99	99	55	56	56	57	58	58	59
	90th	106	107	108	109	111	112	113	69	70	70	71	72	72	73
	95th	110	111	112	113	115	116	116	73	74	74	75	76	76	77
	99th	117	118	119	120	122	123	124	81	81	82	82	83	84	84
8	50th	95	95	96	98	99	100	101	57	57	57	58	59	60	60
	90th	108	109	110	111	113	114	114	71	71	71	72	73	74	74
	95th	112	112	114	115	116	118	118	75	75	75	76	77	78	78
	99th	119	120	121	122	123	125	125	82	82	83	83	84	85	86
9	50th	96	97	98	100	101	102	103	58	58	58	59	60	61	61
	90th	110	110	112	113	114	116	116	72	72	72	73	74	75	75
	95th	114	114	115	117	118	119	120	76	76	76	77	78	79	79
	99th	121	121	123	124	125	127	127	83	83	84	84	85	86	87
10	50th	98	99	100	102	103	104	105	59	59	59	60	61	62	62
	90th	112	112	114	115	116	118	118	73	73	73	74	75	76	76
	95th	116	116	117	119	120	121	122	77	77	77	78	79	80	80
	99th	123	123	125	126	127	129	129	84	84	85	86	86	87	88

Blood Pressure Levels for Girls by Age and Height Percentile (Continued)

Age (Year)	BP Percentile ↓	Systolic BP (mmHg)							Diastolic BP (mmHg)						
		← Percentile of Height →							← Percentile of Height →						
		5th	10th	25th	50th	75th	90th	95th	5th	10th	25th	50th	75th	90th	95th
11	50th	100	101	102	103	105	106	107	60	60	60	61	62	63	63
	90th	114	114	116	117	118	119	120	74	74	74	75	76	77	77
	95th	118	118	119	121	122	123	124	78	78	78	79	80	81	81
	99th	125	125	126	128	129	130	131	85	85	86	87	87	88	89
12	50th	102	103	104	105	107	108	109	61	61	61	62	63	64	64
	90th	116	116	117	119	120	121	122	75	75	75	76	77	78	78
	95th	119	120	121	123	124	125	126	79	79	79	80	81	82	82
	99th	127	127	128	130	131	132	133	86	86	87	88	88	89	90
13	50th	104	105	106	107	109	110	110	62	62	62	63	64	65	65
	90th	117	118	119	121	122	123	124	76	76	76	77	78	79	79
	95th	121	122	123	124	126	127	128	80	80	80	81	82	83	83
	99th	128	129	130	132	133	134	135	87	87	88	89	89	90	91
14	50th	106	106	107	109	110	111	112	63	63	63	64	65	66	66
	90th	119	120	121	122	124	125	125	77	77	77	78	79	80	80
	95th	123	123	125	126	127	129	129	81	81	81	82	83	84	84
	99th	130	131	132	133	135	136	136	88	88	89	90	90	91	92
15	50th	107	108	109	110	111	113	113	64	64	64	65	66	67	67
	90th	120	121	122	123	125	126	127	78	78	78	79	80	81	81
	95th	124	125	126	127	129	130	131	82	82	82	83	84	85	85
	99th	131	132	133	134	136	137	138	89	89	90	91	91	92	93
16	50th	108	108	110	111	112	114	114	64	64	65	66	66	67	68
	90th	121	122	123	124	126	127	128	78	78	79	80	81	81	82
	95th	125	126	127	128	130	131	132	82	82	83	84	85	85	86
	99th	132	133	134	135	137	138	139	90	90	90	91	92	93	93
17	50th	108	109	110	111	113	114	115	64	65	65	66	67	67	68
	90th	122	122	123	125	126	127	128	78	79	79	80	81	81	82
	95th	125	126	127	129	130	131	132	82	83	83	84	85	85	86
	99th	133	133	134	136	137	138	139	90	90	91	91	92	93	93

BP, blood pressure

* The 90th percentile is 1.28 SD, 95th percentile is 1.645 SD, and the 99th percentile is 2.326 SD over the mean.

For research purposes, the standard deviations in Appendix Table B–1 allow one to compute BP Z-scores and percentiles for girls with height percentiles given in Table 4 (i.e., the 5th,10th, 25th, 50th, 75th, 90th, and 95th percentiles). These height percentiles must be converted to height Z-scores given by (5% = -1.645; 10% = -1.28; 25% = -0.68; 50% = 0; 75% = 0.68; 90% = 1.28%; 95% = 1.645) and then computed according to the methodology in steps 2–4 described in Appendix B. For children with height percentiles other than these, follow steps 1–4 as described in Appendix B.

Inderx

A

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